

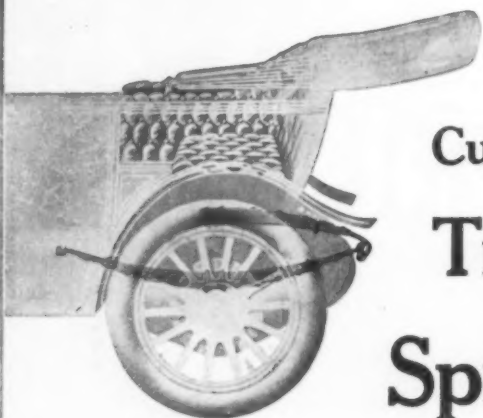
SCIENTIFIC AMERICAN



THE SOMERSAULTING AUTOMOBILE AT THE HIPPODROME

The Problem of Our Navy—How the Navy Is Daily Employed

By Hon. FRANKLIN D. ROOSEVELT, Ass't Secretary U. S. Navy



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Soldering and Brazing

for nearly all metals, including such difficult ones as cast iron and aluminium, have been the subjects of hundreds of paragraphs in the Scientific American Supplement. We quote a few of the more important articles, as follows:

Scientific American Supplement No. 1673—*Full Instructions for Mending or Welding Cast Iron*, gives both brazing solders and fluxes necessary.

Scientific American Supplement No. 1713—*Brazing Cast Iron and Other Metals*, gives detailed instructions for the whole operation, and formulas.

Scientific American Supplement No. 1644—*Soldering and Soldering Processes*, gives broad general information, and contains in particular a method for pulverizing solders and alloys of great use.

Scientific American Supplement No. 1667—*Some Soldering Appliances*, describes the blow-pipe and the furnace in their various forms.

Scientific American Supplement No. 1481—*Soldering of Metals and Preparation of Solders* gives many formulas for soft and hard solders and fluxes.

Scientific American Supplement Nos. 1610, 1622, 1628 contain a series of three articles on Solders, covering the entire range of solders for all metals. No. 1628 contains formulas and instructions for soldering aluminium.

FOR 80 cents—the price of the eight numbers, post-paid, the purchaser of these Supplements has a complete treatise on the subject of Soldering and Brazing, containing formulas of the greatest value.

EACH number of the Scientific American or the Supplement costs 10 cents. A set of papers containing all the articles here mentioned will be mailed for 80 cents. Send for a copy of the 1910 Supplement Catalogue, free to any address. Order from your newsdealer or the publishers.

MUNN & CO., Inc., 361 Broadway, New York City

The Gyroscope

The mysterious behavior of the gyroscope is a source of wonder to everyone. From a curious toy, the gyroscope is being developed into a device of great practical value. Its theory and its method of action are set forth up to the latest moment in the Scientific American Supplement. The following numbers are of great interest and usefulness:

Scientific American Supplement No. 1501—*Treats of the Mechanics of the Gyroscope*. A clear explanation without mathematics.

Scientific American Supplement No. 1534—*"Little-known Properties of the Gyroscope"* describes a peculiar action not generally observed, and discusses the effect of this property upon the motions of the planets.

Scientific American Supplement No. 1664—*The Gyro Compass*, its principle and construction.

Scientific American Supplement No. 1621—*The Gyrostat for Ships* describes the construction and application of the principle to prevent rolling of vessels.

Scientific American Supplement No. 1943—*Gyroscopic Stabilizer for Ships*, by Elmer A. Sperry.

Scientific American Supplement No. 1694—*Gyroscopic Apparatus for Preventing Ships from Rolling*, takes up the Schlick invention described first in No. 1621, and discusses its action and results fully.

Scientific American Supplement No. 1645—*The Theory of the Gyroscope* is an excellent article, treating the subject mathematically, rather than popularly.

Scientific American Supplement No. 1649—*The Gyroscope*, is an article giving a full discussion of the instrument without mathematics, and in language within the comprehension of all interested.

Scientific American Supplement No. 1716—*A Recent Development in Gyroscopic Design*, illustrates a new form of gyroscope and mounting adapted to engineering uses.

Scientific American Supplement No. 1643—*The Gyroscope for Balancing Aeroplanes*, takes up this interesting field, which the gyroscope alone seems capable of occupying.

Scientific American Supplement No. 1741—*Gyroscopic Balancing of Aeroplanes*, tells of various suggested methods of maintaining equilibrium.

Scientific American Supplement No. 1773—*The Wonderful Gyroscope*, gives diagrams of the Gyroscope and its action, and applications to maintaining stability of ships and monorail trains.

Scientific American Supplement No. 1872—*The Mechanical Principles of Brennan's Mono-rail Car*. A lucid exposition.

Scientific American Supplement No. 1814—*The Regnard Aeroplane*, describes the latest design of aeroplane stabilizer, from which great things are expected.

Scientific American Supplement No. 1861—*The gyrostatic force of rotary engines*, its nature and significance for aviation.

EACH number of the Supplement costs 10 cents. A set of papers containing all the articles here mentioned will be mailed for \$1.50.

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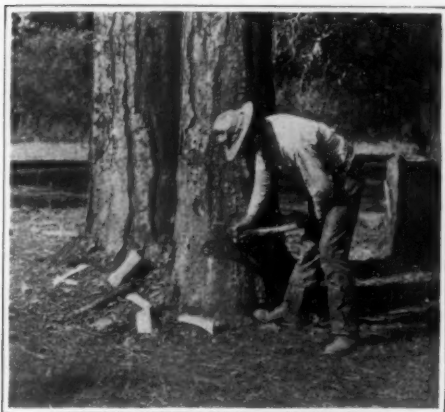
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

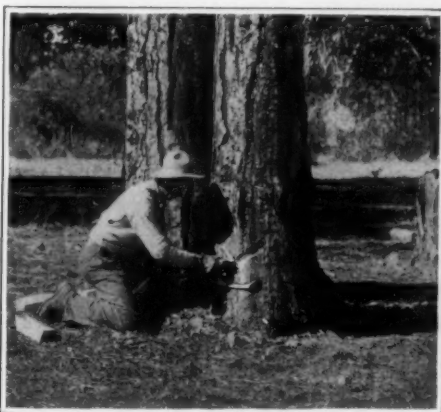
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NEW YORK, FEBRUARY 28, 1914

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Method of removing the outer bark in preparation for setting the apron and the cup for a flow.



Striking or chipping. Starting the face. Note the nail (below the apron) upon which the cup is set.



Showing the method of setting the apron in orchard turpentine after removal of the bark of the tree.

Prolonging the Naval Stores Industry

By Samuel J. Record, Assistant Professor of Forest Products, Yale University

THE future of the naval stores industry in the United States is a matter of grave concern. Wasteful methods of boxing and chipping are carried on in advance of logging operations and no provision is made for continual production. Long leaf and Cuban pines of the South have long been the chief source of the world's resin supply, but the stands of these trees are rapidly being cut. The demand for naval stores, however, is increasing, and this has led to the boxing of smaller trees and of species which formerly were not considered worth while. With depletion of the forests the industry has advanced farther and farther west until practically the whole range of long leaf pine has been covered. There is no other region to exploit unless it be the far West. Investigations of the yield of resin from western pines indicate a possible future for the naval stores industry, but it can never approach conditions in the south Atlantic States.

Decrease in supply has also stimulated the distillation of pine wood and while there is considerable prejudice against the turpentine thus obtained it nevertheless has a promising future. Improved methods of distillation are coming into use which overcome most of the objections to wood spirit.

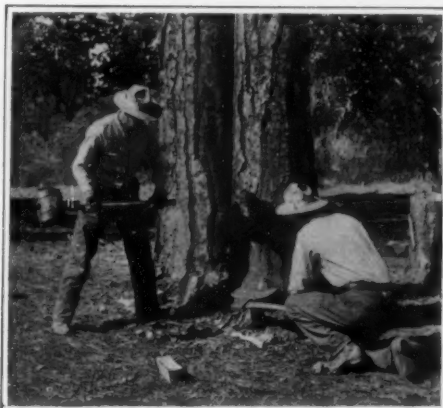
For ten years the United States Forest Service has been experimenting with improved methods of turpentine orcharding. Instead of the destructive box cut into the base of the tree, thereby weakening it and rendering it particularly liable to fire damage, a system of cups and gutters was shown to be successful. The adoption of this method has been slow and even at the present time the old way is still common.

The next important feature of turpentine presenting itself for investigation was in regard to the proper depth, width and height of the wound made on a tree in chipping. Some of the results of the comparative experiments conducted on a commercial scale under normal conditions demonstrate that combined shallow and narrow chipping increases the yield; that the number of trees killed is decreased; and that the damage to the lumber in the butt cut of chipped trees is reduced.

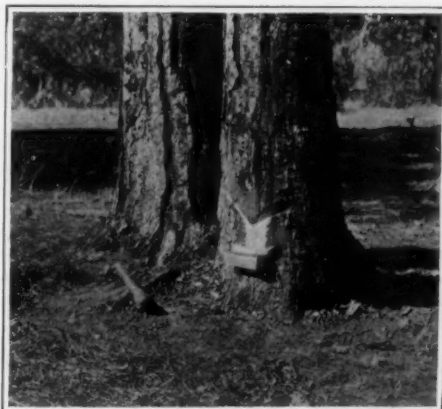
Light cupping, that is, restricting the operation to timber over twelve inches in diameter, and closely limiting the number of cups per tree, has proved to be highly advantageous since it prolongs the period during which a crop can be worked and by exempting the young trees prevents the exhaustion of the timber available for turpentine in future, thus assuring stability and perpetuity to the naval stores industry.

Resin will not continue to flow indefinitely from a cut, hence frequent chipping (once a week or oftener) throughout the season is necessary to maintain the flow. Cuban pine bleeds much longer than any others, producing almost no "scrape." The thickness or rather the height of the chip taken off determines the rate of advance of the face up the tree. The more cut off at a

time the sooner the face will get beyond the reach of the chipper. It has been demonstrated that a thin shaving will accomplish as good or even better results than a heavy cut. With the ordinary hack, however, this is difficult to regulate, and a new hack has been invented which works on the principle of a safety razor. The thickness of chip can be gaged accurately even



The operation of making the groove in the tree. The concave ax employed for setting the apron.



A fairly typical face. The hack, which shaves on the principle of a safety razor, lies beside the tree.

after repeated sharpening of the hack blade. It is so made that the inside edge is flat instead of curved, thus leaving the cut face smooth instead of scalloped. This facilitates the flow of resin into the cups.

The question of running the face spirally instead of straight up the side of the tree is being considered. The advantage of the spiral would be in extending the

length of time a tree could be chipped before the face got beyond reach of the long-handled hack. It might at first appear that the effect of a spiral face would be to girdle the tree as soon as it had extended entirely around. Such is not the case, however, since the movement of the sap is not in straight lines, but from one cell to another through pits in the side walls. The sap stream would accordingly follow the spiral of uninjured wood without material interruption.

A method of resin gathering for which a great deal has been claimed consists of boring slanting holes in the sapwood and draining the resin into a closed cup. This was supposed to prevent the closing of the resin ducts by oxidation of the resin, thus permitting a continuous flow. This and similar methods fail to take into account the physiological processes involved in resin formation.

Resin is a waste product resulting from the vital processes of growth. It is not, as many assert, a healing balsam especially produced by the tree to protect wounds; such a function of it being purely incidental. In the change of starch into exactly the kind of food the plant wants a complex substance is left over as a by-product. This is called resin and is found in parenchyma cells since they alternately store up and give out starch and other plant food, according to the season.

If several resin cells or parenchyma cells are close together the amount of by-product (resin) becomes too large to be contained in the cells and is excreted into intercellular spaces. Such spaces are known as resin ducts and are characteristic of the wood of our pines, spruces, larches and Douglas fir. Most of them extend up and down the stem, but many occur in the large medullary rays. These ducts are for use in the storage of resin and not for its transfer from one part of a tree to another. In this function as well as the absence of a wall of their own they differ from the vessels of hardwoods. None of our hardwoods contain resin ducts in the wood, though many species of *Dipterocarpaceae* in the Philippines are so characterized. The milk of dandelion, of milkweed, and the latex of rubber trees is also a by-product similar to resin in formation.

In tapping a tree comparatively little resin is actually secured from the ducts already in the wood. The main flow is not out of the old ducts like sap out of cut vessels, but is from new ducts which arise as a consequence of the injury. Wounding, such as chipping, stimulates the vital processes at the seat of injury and greatly increases the by-product, resin; and in consequence there is an increase in the number of ducts necessary to contain it. It is from these secondary ducts that most of the commercial yield of turpentine is secured.

The first wound results in the formation of a number of new or secondary resin ducts from both above and below the injury, the length of those above being greater than those below. Subsequent chipping of course affects only the upper edge of the first wound. The first wound is usually made in winter when all hands are engaged either in placing the cups on the

(Concluded on page 186.)

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Problem of Our Navy

THE SCIENTIFIC AMERICAN commences in this issue the publication of a consecutive series of articles on "The Problem of Our Navy," than which problem, as affecting our international interests and our standing as a great world power, there is no question before the people of the United States and its Congress of greater and more pressing importance.

During the past thirty years, or since the time when a Democratic Administration commenced the construction of an entirely new navy of steel, and set afloat such cruisers as the "Chicago," "Olympia," and the vessels of "The White Squadron," and that famous trio of battleships, the "Oregon," "Massachusetts," and "Indiana," the SCIENTIFIC AMERICAN has recorded the steady growth of the Navy, so far as its materiel is concerned, and by photograph, drawing and descriptive text, has kept the public in close touch with the various ships, as they came from the builders' hands and went into active commission.

We feel that the time has now come to take a broader view of this most important subject, and show how vitally the Navy is related to those stupendous international policies, such as the Monroe Doctrine, the Integrity of China and Asiatic Exclusion, upon which the United States has recently taken such a bold stand—with regard to which it is at this very moment assuming an attitude that admits of no compromise whatsoever.

The spirit of the articles will be at once laudatory and critical, and as an evidence of the happy combination of these two attitudes, we direct special attention to the first of the series, by Assistant Secretary of the Navy Franklin D. Roosevelt, as published elsewhere in the present issue.

Canal Tolls Sophistries

DISPATCHES from Washington indicate that the President will meet with strong opposition in the House of Representatives to his proposed repeal of that clause of the Panama Canal Act which exempts coastwise traffic from the payment of tolls. If Representative Underwood, the Democratic leader of the House, is correctly reported in the New York Times, he is making an investigation of the probable effect of an amendment to the Canal Act extending free tolls on their domestic commerce to all nations. How this would better the situation we fail to see. To meet the fixed and operating charges of this \$400,000,000 enterprise will require the gathering in of every dollar of legitimate earnings that it can secure. Exemption of our coastwise traffic would cut down the revenues enormously; and Mr. Underwood's proposal to exempt the domestic commerce of all nations would not only reduce the revenues in a still larger measure, but would make the discrimination most painfully apparent in the case of those nations that have no domestic commerce to send through the canal.

Mr. Underwood is quoted as saying that in the United States we have never charged domestic commerce a toll for the use of any waterway improved at the expense of the Government, and that to do so at Panama would be an innovation. Well, what of it? All new legislation is more or less of an innovation, and in this case the innovation is necessitated by treaty obligations of the clearest and most binding character.

It seems to us that there is more of sophistry than good logic in arguments such as these, and especially in the following: "Now mark this inconsistency," Mr. Underwood is quoted as saying. "The rules for the government of the Suez Canal, as embodied in the treaty of Constantinople, are those we adopted for the government of the Panama Canal. All the principal powers of Europe signed that treaty. Yet, though Russia, one of the signers, makes an annual appropriation to pay the tolls of her domestic commerce through the Suez Canal, Great Britain never has protested." But why should she? The Hay-Pauncefote treaty leaves all nations free to pay back to the shipping companies amounts equal to the tolls charged for passage through the Panama Canal, if they feel disposed so to do. That is a question affecting the individual governments and the shipping companies which may use the Canal. The treaty between the United States and Great Britain takes no cognizance of such matters. If the United States Government charged equal tolls to our coastwise shipping and then voted from the Treasury sufficient money to repay these tolls to the coastwise shipping companies, there could be no protest from Great Britain or any other maritime country against such procedure.

Alphonse Bertillon

IN the popular mind the fame of the late Alphonse Bertillon rests entirely on the introduction of the anthropometrical and finger print methods of identifying criminals. Magnificent as was the achievement of co-ordinating the police headquarters of the world, so that it is now a matter of routine for the bureaus of criminal identification in the larger American and European cities to exchange measurements and fingerprints, Bertillon's reputation rests on a broader basis of scientific achievement. Indeed, the anthropometrical system is eventually bound to give way to Galton's fingerprint method, which Bertillon was reluctantly compelled to accept and introduce.

What the police forces of our great cities owe to Bertillon is the injection of a scientific spirit into the work of tracking criminals. His *Bureau d'Identification judiciaire* has been a model laboratory in which the police of the world have been shown how the evidence of crime may be studied scientifically. Its counterpart should be found in every American city—a wish that will probably not be realized for decades to come. When the full significance of the scientific methods that Bertillon introduced into the French police system is appreciated, we will wonder why we ever tolerated the present system, why criminals in this twentieth century are still tracked by detectives who are nothing but promoted policemen and who can use only in the crudest kind of way, the clues that are placed at their disposal. Some day there will be found at the head of every detective bureau a man with Bertillon's outlook and scientific spirit—a man who will have as his subordinates not uneducated policemen and detectives, but men trained to deal with crime in a systematic scientific way.

Requirements of the Automatic Train Stop

WE recommend for the study of all who are engaged on the automatic train stop problem a review, in booklet form, by Mr. Joseph W. Buell of Washington, of the principles underlying the design and construction of automatic stop apparatus as applied to the control of railroad trains. The author, himself an inventor of a well known system, has devoted many years to the study of cab signals and automatic stops and is well qualified to discuss the various branches of this subject and its relation to wayside signaling.

At the outset it is pointed out that previous developments in railway signaling have had to meet exacting requirements; and that the demand for greater efficiency in safeguarding railroads by the employment of automatic stops, necessitates that their design and operating principles be subjected to the same rigid treatment with respect to their pre-requisites, as has characterized previous development in the existing methods of signaling.

After a brief discussion of the engineering rules that govern the problem, some space is given to the physical side of the question and particularly to the perplexing problem of satisfactorily providing either a mechanical or an electrical means for transmitting an impulse from the track to a traveling locomotive in order to actuate the mechanism thereon, and to doing this in as reliable a manner as has been found in the automatic production of a roadside signal on a mast or post.

The various systems of automatic stops offered for approval may be conveniently classified as six distinct methods or types for communicating motion, or producing an electrical effect, on a traveling locomotive by reason of a danger-giving condition of the track. Mr. Buell points out that, in the study of these sys-

tems, every aspect of the problem becomes clear and simple and there is provided a method for appreciating the real value of any one of these systems. But in considering their relative merits we must confine our attention to the vital consideration of the degree of excellence of the means used for establishing operating connections, or contacts, between the tracks and the locomotive. Furthermore, it must be borne in mind that in whatever manner this be done, it is imperative that the operating principle involved shall satisfy the fundamental requirements of observing the engineering rule of "failure on the side of safety."

In dealing with the problem of establishing connection or contact between the track and a traveling locomotive Mr. Buell has classified the different systems, aside from the one which transmits an electrical or magnetic impulse through the air, as follows:

First, a contact obtained by impact or blow. Second, a yielding contact obtained by pressure of a traveling part, carried by the locomotive, upon a stationary part on the track. Third, a rolling-wheel contact, obtained by the pressure of the wheels of the locomotive on the traffic rail. Every step in the development of each type is clearly set out, and a brief account is given, in a practical but scientific way, of the various types of automatic stops such as the Trip, Third-Rail, Ramp, Wireless, etc., and the author sets forth impartially the advantages claimed for each; how their merits should be respectfully judged by accepted standards; and at the same time the disadvantages involved in each type are shown. The author finds a prospect for the survival of the Ramp type and the Rolling-wheel Contact Type. The latter he regards as the ideal one for reasons that are given at some length.

There is a demand for literature of a compact but comprehensive form dealing with this problem; and a reading of this booklet will be found useful to inventors in clearing the air, as it were, and settling them on firm ground with regard to fundamental principles and practical requirements.

The Next 900-foot Atlantic Liners

THAT the 900-foot transatlantic liner is a profitable investment is proved by the fact that this summer there will be three ships in service between Europe and America which will be over 900 feet in length. These will be the "Imperator," which, during the winter months, has been undergoing considerable modifications, the new "Aquitania" of the Cunard Line, which is due here next June, and the "Vaterland," of the Hamburg-American Line, which will make her maiden voyage to New York in the early summer. The "Aquitania" is 901 feet long, the "Imperator," 900 feet, and the "Vaterland," 940 feet, these being the lengths over all. In the same class should be mentioned the White Star liners "Olympic," now in service, and the "Britannic," which was recently launched and is being rapidly pushed to completion.

The "Aquitania" will be an enlarged "Mauretania," with a displacement about 50 per cent greater. She will be driven by quadruple turbines working on four shafts, and her horse-power will be about the same as that of the "Mauretania," although the speed, due to the great increase in displacement and the somewhat fuller lines of the hull, will be less. The "Mauretania" has crossed the Atlantic at an average speed of 26.01 knots, and it is expected that the "Aquitania" will be capable of a sustained sea speed of something over 23 knots. With her full equipment on board, the new ship will have a displacement of about 55,000 tons. With a length on deck of 901 feet, she has 97 feet of beam and a plated depth of 64 feet.

The safety elements in the "Aquitania" are broadly similar to those embodied in the "Lusitania" and "Mauretania." For five hundred feet of her length she consists of a shell within a shell, the coal bunkers being carried at the sides of the ship in the wake of the boiler rooms. The inner wall of the bunkers is about 15 feet from the outer shell, and the whole of the boiler and engine spaces is subdivided by six bulkheads extending from side to side. These bulkheads have been specially stiffened; and with them is associated a watertight deck in the neighborhood of the water line. An interesting fact is that the ship will carry two 40-foot and two 30-foot motor lifeboats, which, in case of emergency, will suffice to tow all the other boats, including twenty-five large rowing boats and a large number of the collapsible type.

The "Vaterland," an enlarged "Imperator," is 940 feet long with 100 feet of beam and a plated depth of 73½ feet. She will differ from the "Imperator" in underwater form, being constructed with a cruiser stern and will carry a balanced rudder operated by steering gear which will be entirely below the water line. She will probably be a knot or more faster than the "Imperator," and of four or five thousand tons greater displacement, this at full load being something over 60,000 tons. A sister ship of equal dimensions and beam is under construction at the Blohm & Voss yards, where the "Vaterland" is now receiving her finishing touches.

Engineering

Third-tracking the Elevated Railroad.—The Interborough Rapid Transit Company, of New York city, has awarded the contract for third-tracking the Second, Third and Ninth Avenue Elevated Lines. The estimated cost of the work is about \$17,000,000.

Decrease in New Railroad Construction.—Statistics for the past year show that there has been a decrease in the mileage of new lines under construction from 2,500 miles on January 1st, 1912, to 1,522 miles on January 1st, 1913. According to the *Railway Age Gazette*, the outlook for new construction is not promising for the year 1914, which will probably witness a still further decrease. In Canada there are 1,568 miles of new line under construction as compared with 3,500 miles one year ago.

Output of Coal in 1913.—According to the official estimate of the United States Geological Survey, the output of coal in the United States during 1913 amounts to between 565,000,000 and 575,000,000 short tons. Edward W. Parker, coal statistician of the Survey, has stated that the coal-mining industry, in spite of an increase of 30,000,000 tons over the year 1912, was perfectly normal, and that the figures are to be taken as showing the great industrial activity throughout the country.

Ships that Break in Two.—In our recent editorial entitled "Ships that Break in Two," it was stated that an accident of this character occurred to the British destroyer "Viper." The vessel that broke in two was the sister destroyer "Cobra," which foundered in the North Sea on September 18th, 1901, with a loss of seven lives. The Admiralty inquiry showed that her loss was due to structural weakness. Curiously, the "Viper" was lost in the same year through running aground in the Channel Islands.

A Substitute for "Watch Your Step."—The Interborough Rapid Transit Company has perfected a mechanical gap-filling device which will be used at subway stations which are on a curve. It consists of a grating segment of the platform which is thrust forward, filling the gap between car and edge of platform, the movement being made just before the train comes to a stop. The grating remains in this position until the train has started and moved a distance of 7 or 8 feet. The gap-filler is operated by electro-pneumatic cylinder action.

Revival of the Big Sailing Ship.—The development of the heavy oil engine bids fair to bring about a revival of the big square-rigged sailing ship. The latest of this type is a truly magnificent vessel, "The France," launched by the Chantiers de la Gironde at Bordeaux. She is 430 feet long, 55½ feet beam and draws 24 feet when loaded to a displacement of 10,650 tons. Her auxiliaries consist of twin Schneider-Carls oil engines of 925 horse-power, which drive the ship at a speed of 10½ knots, the fuel consumption on the brake test being 0.45 pound per brake horse-power per hour. Her lines are finer than those of the ordinary tramp steamer, and under sail alone she should be capable in a whole-sail breeze of making 16 knots.

Stopping Express Trains in Their Own Length.—A most important development of the air brake was demonstrated in recent experiments on the Pennsylvania Railroad when a twelve-car steel train, nearly 1,000 tons in weight, running 60 miles an hour, was stopped within its own length of about 1,000 feet. The new Westinghouse brake may be operated with pneumatic or electric control, and it embodies among other improvements two shoes for each wheel instead of one, as at present. The new apparatus shortens the time of obtaining the maximum brake capacity from 8 seconds in the present system to 3½ seconds. With electric control, the time is shortened to 2¼ seconds. It was shown that a twelve-car steel train running 80 miles an hour could be stopped within 2,000 feet.

A Comparison of Broadships.—Rear-Admiral Vreeland has filed with the House Committee on Naval Affairs a statement showing that in total muzzle energy of one broadside, the dreadnoughts of the German navy are twice as strong, in the aggregate, as the American dreadnoughts. In pre-dreadnought ships, the United States shows a heavier total muzzle energy than Germany; but combining both dreadnoughts and pre-dreadnoughts the total muzzle energy of the German fleet is stronger than that of the American fleet in the proportion of 11 to 8.

American Manager for English Railroad.—The appointment of Mr. Henry Worth Thornton, General Superintendent of the Long Island Railroad, as General Manager of the Great Eastern Railway Company in England, has been well described as "a personal compliment to Mr. Thornton, and a profound appreciation of American railroads and their men." The appointment has raised the inevitable "tempest in a teapot" in the British daily press. As a matter of fact, the appointment does credit to the judgment of the directorate of the Great Eastern Railroad, which handles the heaviest suburban passenger service into and out of London. Mr. Thornton will look at the problem from new standpoints, and with the advantage of a wide and varied experience.

Science

Soundings in Lake Tanganyika.—Recent soundings in the great African lake by Capt. Jacobs, of the German Navy, showed a maximum depth of 4,190 feet. Still greater depths are reported to have been found by a Belgian official. Accordingly Tanganyika is, with the exception of Lake Baikal, the deepest body of fresh water in the world, and further investigations may prove it to be even deeper than Baikal. In the deepest places thus far found, its bottom is at least 1,600 feet below sea-level.

An Aerial Tramway Across the Andes.—Work has been begun on a remarkable steel ropeway, 37½ miles long, which will serve as an extension of the railway from Ladorada to Mariquita, in Colombia, carrying the line over the Andes at an altitude of 11,000 feet. The steel rope is to be supported on a series of steel towers, from 40 to 125 feet in height, and will consist of 12 sections, at each junction point of which a motor will be installed of sufficient power to work two sections. Power is to be furnished by water brought down from the Andes.

Pili Nuts, which grow abundantly in the Philippines, have recently been shipped on a considerable scale to the United States. They are produced by trees of the genus *Canarium*, to which belongs the Java almond, are nearly triangular in cross-section, and contain a small oily kernel of almond-like flavor. Besides being very palatable in their natural state, they yield a valuable oil, resembling oil of almonds. According to an official report, the production of pili-oil is one of the coming industries of the Philippines, only awaiting the invention of a machine for cracking the nuts, which are very hard.

The Alaska Reindeer Service.—The latest report on this service, just published by the U. S. Bureau of Education, shows that on June 30th, 1912, the total number of reindeer was 38,476, distributed among 54 herds. Of these animals 62.5 per cent are owned by 633 natives; 9.8 per cent by the United States; and 16 per cent by Lapps. At an average value of \$25 a head, the reindeer owned by the natives represent a capital of \$601,700. The income of the natives from the reindeer industry during the fiscal year, exclusive of the value of meat and hides used by the natives themselves, was \$44,885.04. The total number of natives affected by the reindeer enterprise is estimated at about 6,500.

Standard Tests for Hemp.—According to a report from the American consul general at Hongkong, the Fiber Division of the Bureau of Agriculture at Manila is conducting extensive experiments for the purpose of establishing scientific standards for testing hemp, in lieu of the present methods, according to which experts, of many years' experience, judge the quality and value of the product by sight and touch. The new tests will be based upon the relation between the weight of a meter length of the fiber and the breaking strain. Tests for single fibers will be varied with tests for twisted fibers. As soon as this system of tests is fully worked out it will be put into effect in the Philippine hemp market.

Molecular Equilibrium.—O. Lehmann describes a method to determine the elastic limit of a viscous amorphous body. The application of this method to crystalline substances becomes complicated and the phenomena observed can only be explained on the molecular hypothesis and constitute a new proof of this theory. In liquid crystals the molecular equilibrium is related not only to the structure, but also to the form. The molecular equilibrium may be deranged by mechanical forces or by easily graduated magnetic forces. The strong surface tension, for example, produced at the boundary of the air and liquid crystals is able to derange the disposition of the molecules. The molecular perturbations produced by foreign substances able to form crystals mixed with the liquid crystals are the most striking.

True History of the Tepary Bean.—A brief note on the history of the tepary bean published in our science column of June 28th, 1913, and based on a supposedly reliable abstract in a foreign journal of an article by Prof. R. W. Clothier, of the University of Arizona, contained some inaccuracies to which Prof. Clothier has been good enough to call our attention. It appears that the tepary beans were originally found among a lot of beans obtained from the Papago Indians by Director Forbes, of the Arizona Experiment Station. They were tested independently by Prof. Clothier and Director Forbes, at places 400 miles apart, neither seeing the crop grown by the other. Both investigators recognized that they had fallen upon a valuable addition to the crops adapted to the Southwest, and both submitted the beans for botanical identification to Prof. G. F. Freeman, of the Arizona station. During the summer of 1910, Director Forbes and Prof. Freeman visited the Papago Indians in order to seek further information concerning the origin of the beans and secure other varieties. Prof. Clothier has never visited these Indians. The outstanding fact is that Director Forbes and Prof. Clothier are both entitled to the credit of introducing a valuable new crop to the attention of the world.

Aeronautics

A Flight from Cairo to the Cape of Good Hope.—Mare Bonnier, who recently completed a flight from Paris to Cairo, has announced his intention of flying from Cairo to the Cape. The trip may take two months and will be made under the auspices of the National Aero League.

An Optical Telegraph for Flying Machines.—A very interesting optical telegraph was recently tried out at the Breguet aerodrome, near Velizy. The apparatus consists essentially of a tube mounted in the direction of the flying machine's travel. The blast of the aeroplane's propeller is caught by this tube. Hence the tube is traversed by a violent current. Connected with the tube by means of a valve is a small reservoir filled with lamp-black. By opening or shutting the valve, puffs of lamp-black of greater or lesser duration are produced. It is said that these puffs can be seen through powerful field glasses, for about ten miles, and that a message in puffs projected according to the Morse code can easily be read.

New German Military Zeppelins.—The Zeppelin L. Z. 22 has just been completed at Friedrichshafen. It is intended for army use and will bear the number Z VII. It will be stationed at Dresden, where a new shed is in course of construction. Another Zeppelin LI 23, is fast nearing completion. It, too, will be taken over by the army, so that the German military Zeppelins will soon number eight. In the Z VII, some important modifications from the standard Zeppelin construction are embodied. In order to avoid a repetition of the frightful disaster sustained by the L II, last December at Johannisthal, the cars in which the engines are contained are hung somewhat lower, with the result that the air may circulate freely between the envelope and the cars. It is said that Count von Zeppelin has definitely abandoned the idea of running the saloon or passageway which connected the two cars in Zeppelins, within the envelope itself as was the case in the L II.

Surgical Work of Aeroplanes in War.—Several interesting suggestions as to the uses to which aeroplanes might be put by the medical services in time of war were made by Lieut. Colonel J. D. F. Donegan, R.A.M.C., in the course of a lecture at the Royal United Service Institution, Whitehall. As regarded the use of aeroplanes for scouting for wounded on the battlefield, he could not at present realize their element of utility, but it was possible that at some future date aerial transport would simplify the duties of administrative medical officers on the field. The late Colonel Cody was deeply interested in the question of the provision of surgical assistance. From experiments made with both his machines, Colonel Cody and others were confident that it was perfectly possible to carry for long distances a specially designed operating table, with all surgical contents, and an operator, an assistant, and an anesthetist, in addition to the pilot. Passing to consider the feasibility of his proposals, the lecturer explained that they were not for to-day or to-morrow. It would be quite time enough to consider the matter seriously when we were in possession of machines with the lifting power necessary to convey three officers, in addition to the pilot, provided that they were not at present available or in course of construction. The question of opposing forces objecting to aeroplanes engaged in medical work flying over their positions might be arranged amicably.

Fire-Proofing Aeroplane Fabric.—The object of fire-proofing a fabric of any kind is not the prevention of the charring or burning of the material but the prevention of the spreading of the flame which comes in contact with the fabric at any spot. It is better, therefore, to use the word "flame-proofing." For the flame-proofing of fabrics in general, there are two methods used, according to P. W. Litchfield, factory manager of the Goodyear Tire and Rubber Company. First, the impregnation of the fabric and the coating of the same with a non-inflammable mineral constituent, which must be either fused or mechanically broken away before the fiber can burn. Second, the presence of some salt, which, in addition to the above action, will give off some gas such as carbon dioxide that displacing the oxygen, will prevent further propagation of the flame. There are three or more ways of carrying out this impregnation, one being the simple impregnation of the fiber with the mineral constituent as such; or, second, the use of such substances as glue, starch, dextrin, etc., as an adhesive for retaining the mineral constituent on the fiber, by first treating with a solution of such a compound as soluble phosphate, and then immersing in a bath of alum, whereby the insoluble aluminum phosphate is formed in the fabric. Coming to the fire-proofing of balloon fabric, it is more difficult because of the usual presence of rubber, which gives a new factor to the proposition. Here, perhaps, the presence, in the coating of compounds which liberate non-inflammable gases is more suitable than heavy loading of the fabric with mineral constituents which would increase the weight of the fabric and therefore be out of the question. There is, however, a difference in various rubber compounds as to the rapidity of flame spreading, due to the properties of the rubber itself and to the compounding and vulcanization.

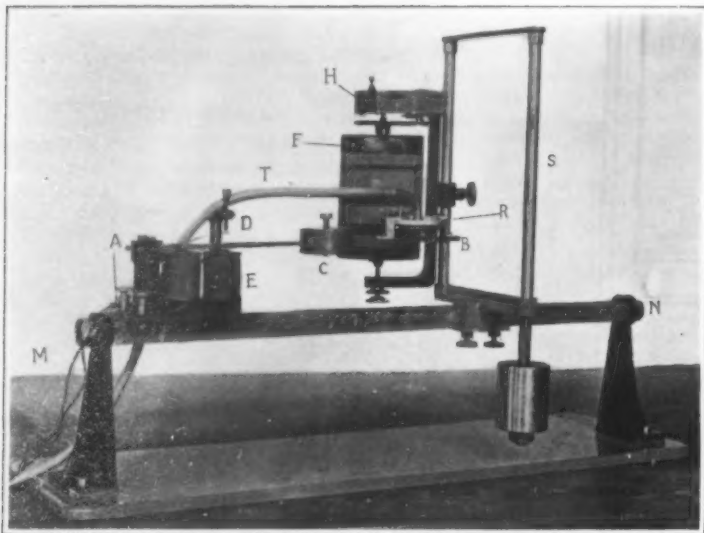


Fig. 1.—Calibrating apparatus of the vibrometer.

AB, vibrating rod; E, electromagnet; R, receiving capsule of vibrometer; C, sliding weight; D, regulating screw; F, cylinder; H, clockwork; S, supporting frame; MN, carrying bar.

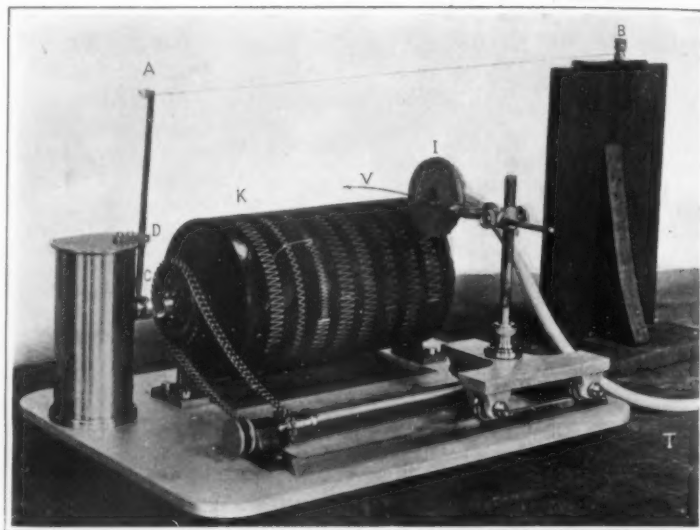


Fig. 2.—Registering cylinder, clockwork and registering capsule of vibrometer.

AB, starting cord; ADC, starting lever; K, cylinder; I, registering capsule; V, tracing stylus. (The clockwork is inclosed in the cylindrical case at the left.)

An Ingenious Instrument for Studying Vibrations

The Bourlet-De Guiche Vibrometer

By Jacques Boyer

THE Bourlet-De Guiche vibrometer is designed for the purpose of registering the frequency and amplitude of the vibrations or oscillations of solid bodies which not only vibrate, but also move in any manner in space. Among such bodies are the frames of automobiles in motion (Fig. 4) and the wings of aeroplanes during flight.

The ordinary registering instruments, which require fixed points of support in the vicinity of the vibrating bodies, are not suited to these cases, in which the registering apparatus must participate in the general motion and select the vibratory movement for registration.

The Bourlet-De Guiche vibrometer, which its inventors recently submitted to the Paris Académie des Sciences, solves the problem in a complete and satisfactory manner. The apparatus comprises two manometric capsules, connected by a rubber tube. To the flexible membrane of the first capsule, or receiver, is affixed a large and heavy metal disk. This capsule, which is attached to the vibrating body, with its membrane perpendicular to the direction of vibration, participates in the vibratory movement without appreciably affecting it, because the mass of the capsule is very small in comparison with that of the vibrating body, while the inertia of the metal disk impresses upon the membrane a relative and inverse vibration of the same period as that which it is desired to register. The variations of pressure thus produced in the receiving capsule are communicated through the rubber tube to the second, or registering, capsule, which resembles an ordinary Marey capsule, and is provided with a stylus that writes a trace of its movements on a rotating cylinder coated with lamp-black.

A summary calculation shows that the relative motion of the disk with respect to the receiving capsule is compounded of a principal vibration synchronous with the vibration to be registered, and a secondary vibration due to the elasticity of the membrane. MM. Bourlet and De Guiche have constructed their vibrometer in such a manner that this secondary movement is entirely negligible. For this purpose they employ a thick, tightly-stretched membrane and a metal disk large enough to cover the whole of the membrane except a narrow annular margin. In these conditions calculation shows that, for a given frequency of vibration, the amplitude a' of the oscillations of the tracing point varies in proportion to the amplitude a of the vibrations which are to be measured, but that the ratio between these two amplitudes is a decreasing function of the frequency.

The following theoretical deductions

have been confirmed by experiment: 1. The secondary vibration is absolutely negligible and usually imperceptible, so that the synchronism of the tracing point with the vibration to be measured is assured. 2. For given frequency the ratio between the amplitudes a and a' (the ratio of damping) remains constant when a varies. 3. This damping effect increases with the frequency.

Before the vibrometer can be used on a vehicle it must be calibrated in the laboratory. The calibrating apparatus (Fig. 1) consists essentially of a metal rod AB, fixed at the end A and kept in vibration by means

of an electromagnet E. The receiving capsule R is attached to the free end B of the rod which impresses upon it a regular vibratory motion. The rod carries a sliding weight C by means of which the period of vibration can be altered, and the amplitude can be regulated by turning the screw D attached to the interrupter of the electromagnet. The vibrations of the rod are registered directly by a stylus on the cylinder F which is turned by the clockwork H. The whole apparatus, including the vibrating rod, the electromagnet and the cylinder with its clockwork H and its support S, is mounted on a horizontal bar MN of square cross-section, which can be turned about its axis in order to place the receiving capsule R in a horizontal or a vertical position at will.

The registering capsule I and cylinder K, with the clockwork that drives the latter, are shown in Fig. 2. When the cord AB is cast loose the lever ADC turns about D and the clockwork is released by the withdrawal of a stop attached to the end C. The clockwork runs light for a few seconds until the helicoidal clutch, which can be seen in the engraving beneath C, has become completely engaged. This device avoids irregularity in starting and assures uniform rotation of the cylinder.

Fig. 3 illustrates the method of conducting a calibrating experiment to determine the damping ratio as a function of the frequency of vibration. After the receiving capsule has been attached to the calibrating rod and connected with the registering capsule by the rubber tube, the rod is set into vibration and both cylinders are started. In this way the vibrations of the rod and of the membrane of the registering capsule (and, if great precision is required, those of a tuning fork also) are registered simultaneously. The experiment is repeated many times, the amplitude of vibration of the rod being varied by means of the regulating screw and its period being changed by moving the sliding weight. The records made on the cylinder K (Fig. 2) give the period of vibration, either from the known rate of rotation of the cylinder or by comparison with the tracings of the tuning fork. Then, after comparison of the records on the two cylinders has proved that the amplitude of the registered vibration bears a constant relation to that of the original vibration, or the same frequency, this ratio is measured for various frequencies, and the measurements are incorporated in a curve or a table, from which the value of the ratio for any frequency, or period of vibration, can easily be deduced. The calibrated vibrometer may be used for measuring the vibrations of any moving body, and especially of automobiles and aeroplanes.

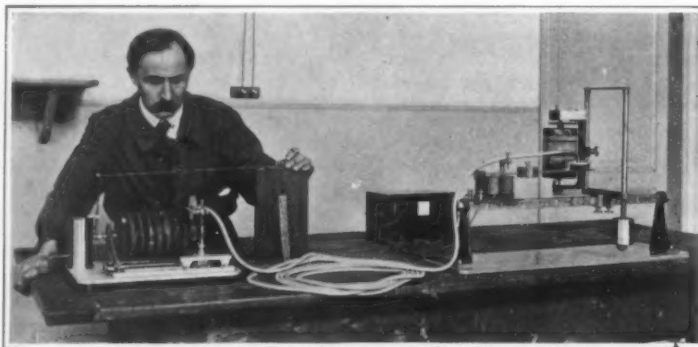


Fig. 3.—Calibrating the vibrometer.

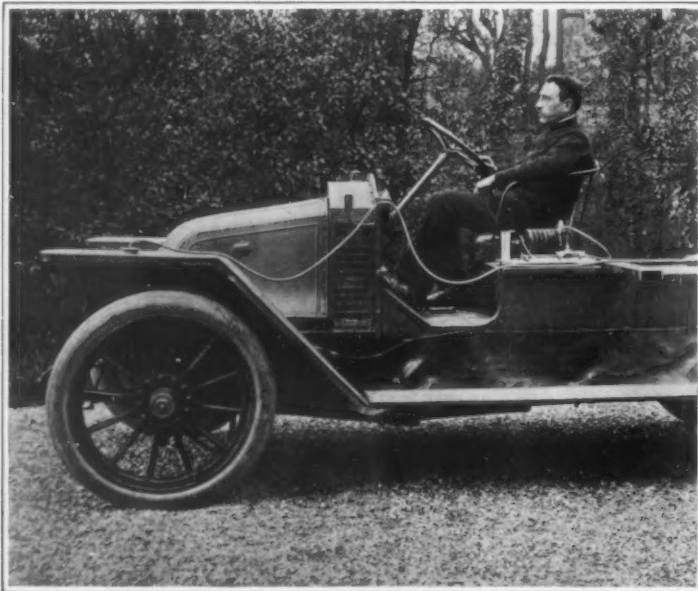
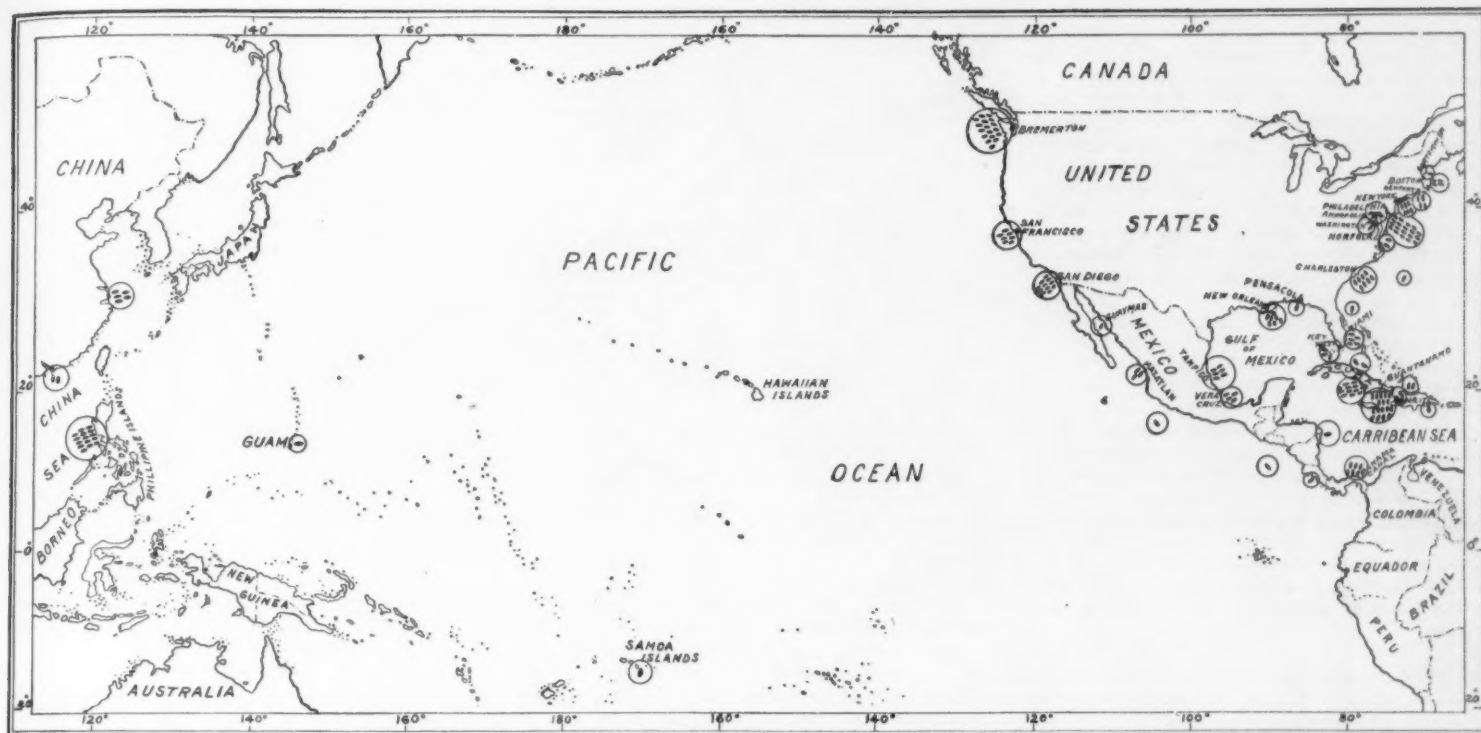


Fig. 4.—Measuring the vibrations of the chassis of a moving automobile by means of the Bourlet-De Guiche vibrometer.



Map showing disposition of ships of the United States Navy on February 12th, 1914.

The Problem of Our Navy

I.—How the Navy is Daily Employed

By Hon. Franklin D. Roosevelt, Assistant Secretary of the Navy

A CERTAIN person of some prominence in public life, who should have known better, recently referred to the American Navy as an organization of "highly paid idleness."

In regard to the pay of the Navy, it is sufficient to dismiss the allegation with the statement that the average pay of all the officers and enlisted men in the service amounts to just \$618 per annum apiece. But the use of the word "idleness" leads me to fear that there must be some people who are not familiar with the manner of occupation of the ships and men of the service in times of peace.

In my office in Washington hangs a map of the world, showing by means of pins the location each day of the ships of the Navy. This map is a constant source of interest and surprise to visitors, and any study of it leads to the inevitable conclusion that our vessels and the men who man them lead an existence of constant occupation and useful effort, that is surpassed by no other agency of the Government of the United States.

It so happened that on the 12th of February, 1914, all the ships of the Navy, with the exception of a small gunboat used as a station ship at Constantinople, were located between the longitude of Santo Domingo on the east and that of Canton on the west. Therefore the appended map includes only that portion of the earth's surface. It should be remembered, however, that only a few months ago we had battleships in the Mediterranean, cruisers in South American waters and in other places not shown on this map, and that it represents only the locations shown on the Department map on the day it happened to be copied for reproduction in the SCIENTIFIC AMERICAN. Every day of the year the pins are changed as the ships move on their never-ending duties.

Some of their occupations are self evident; but a short explanation of why each ship is in each particular place will perhaps in itself give a better answer to the question, "Why have we a navy?" than would a dozen long volumes on sea power or strategy. For the accompanying map shows both the strength and the weakness, the sufficiency and the crying needs of the American Navy to-day.

Starting with the Asiatic fleet, there are shown five light draught river gunboats on the Yangtse River in China and two near Canton, all of them used on a friendly patrol duty which has been going on for many decades.

To the southward concentrated in the Philippine Islands is the main body of the Asiatic squadron, consisting of the following vessels: Cruisers "Saratoga," "Cincinnati," "Galveston," monitors "Monterey," "Monadnock," 1 gunboat; 5 torpedo boat destroyers; 6 submarines; 4 auxiliaries—a total of 21 vessels which in time of peace is sufficient to guard the various American in-

Modern naval wars start with all the surprise and destructive shock of an explosion of dynamite, as witness the Japanese destroyer attack which so seriously crippled the Russian fleet at Port Arthur before any declaration of war had been made. Modern naval wars are won when the battleship fleets meet and fight it out to a finish on the high seas; as happened later when Japan annihilated the Russian first line of battle at Tsushima. The navy of a great nation like the United States must be proportioned to the magnitude of that nation's international policies—to the distance from home and the area of the field in which it may be engaged in hostilities—and above all, to the size and strength of the first battleship line of those nations which may dispute by armed force that nation's policies. As matters now stand, the United States is endeavoring to support first-class policies with a third-class navy. Measured by the daring of our policies and the boldness with which they are being proclaimed, our fighting line of dreadnoughts is about one half as powerful as it should be. The navy, as it stands to-day, is short of men, short of torpedoes, has no comprehensive scheme of swift mobilization—has, in fact, no adequate reserve of men with which to mobilize; and in case of sudden complications with a foreign power over, say, the Monroe Doctrine or the Panama Canal, would find itself incapable of entering into a war with any hope of that quick success, which will be achieved by the nation that engages with a preponderance of dreadnought strength and the ability to mobilize its whole fleet in a week or ten days' time.

These are some of the questions which we shall consider in the series of articles on "The Problem of Our Navy," of which this is the first.

But the Navy, though deficient in quantity—in ships, officers and men—is absolutely first class in quality. That the nation is being well served, day by day, in these times of peace, is shown in the following very able article by the Assistant Secretary of the Navy.—EDITOR.

terests in the island and other parts of the Far East, but which in time of war against any important naval power would be practically a negligible quantity. For it goes without saying that cruisers, old monitors, and a few destroyers and submarines could not long withstand an attack by a modern battle fleet. The maintenance of these ships of small fighting value in the Far East is justified not as a war measure, but because American activities, not only in our own possessions

but in all the neighboring seas and countries, require in time of peace the moral support of the ships' presence.

Moving eastward on the map our next vessel is seen at the island of Guam, serving as a station ship for the island government, which is conducted with conspicuous success by a naval officer. In fact, a comparison of conditions on that out of the way speck in the Pacific with those existing before American occupation, or even with those existing to-day in nearby islands under the rule of another power, shows a real accomplishment of which the Navy and the American people can be proud. The same statement can be made about our other Navy-governed possession of Tutuila, or American Samoa. Here also a gunboat is maintained as a station ship.

Turning now to the northern Pacific, it will be seen that no ships are stationed at Hawaii. This is, however, only a temporary condition, and the completion of the Pearl Harbor Naval Station will make this an important strategic base.

In Puget Sound is located the Pacific Reserve Fleet consisting of the following ships: battleship, second line, "Oregon;" armored cruisers "South Dakota," "West Virginia," "Colorado;" cruisers "Albany," "Charleston," "Chattanooga," "St. Louis," "Milwaukee;" 2 submarines; 5 auxiliaries. These ships are maintained with skeleton crews, and while still serviceable in battle against enemies' ships of equal age, would have small military value against a more modern fleet. In addition to these, a submarine recently completed is being placed in commission at Puget Sound.

In San Francisco Bay are the cruisers "Cleveland" and "Marblehead" (in reserve); 1 gunboat; 4 submarines; 4 torpedo boat destroyers (in reserve); 2 torpedo boats (in reserve); 2 auxiliaries. It may here be noted that the necessity for the presence of ships in Mexican waters and for other important duties makes it highly undesirable to keep so many ships on the Pacific Coast in reserve, but the lack of sufficient officers and men to place them in full commission makes any other course impossible; and this in spite of the fact that the quota of men allowed is at present up to the legal limit.

Near Santa Barbara and San Diego, California, 5 torpedo boat destroyers with a parent ship are engaged in their annual maneuvers and torpedo exercises. Two submarines with an attendant monitor are also engaged in their practice drills in this vicinity, and the armored cruisers "Maryland" and "California" are holding their usual winter target practice. All of this work corresponds to the drills of the Atlantic fleet in West Indian waters each winter, but the shortage of men and the unusual international requirements have of late prevented the carrying out of these exercises in the manner the Department would like to see.

Farther south on the west coast of Mexico are found the armored cruiser "Pittsburgh," cruisers "Raleigh" and "New Orleans," 1 gunboat and 1 auxiliary. The reasons for their presence in these waters require no comment.

Still farther south the cruiser "Denver" is proceeding to relieve the transport "Buffalo" at Corinto, Nicaragua, where for some time the State Department has considered the presence of an American warship desirable. This completes the list of ships in the Pacific Ocean. They seem formidable in numbers, and they are doing valuable work of almost every conceivable kind, but as a fighting force against a modern fleet they must not be highly estimated.

In the Atlantic Ocean is found both the greatest numerical and the chief military strength of the Navy. Far to the north in the Gulf of St. Lawrence, but not shown on the map, the naval tug "Potomac," bound on an errand of mercy to rescue the crews of American fishing boats, has herself been caught in the icefloes and at this writing is in grave danger of destruction. At Portsmouth, N. H., the cruiser "Tacoma" is undergoing repairs. At Boston the second line battleship "New Jersey," recently from Mexico, is being overhauled; the armored cruiser "North Carolina" and the cruiser "Chicago" are in reserve, and a new submarine is being placed in commission. At Newport 4 old torpedo boats are maintained in reserve and a submarine is being fitted out.

At New York the first line battleship "North Dakota" is repairing; the first line battleship "Arkansas" is in quarantine with a few cases of illness on board; the armored cruiser "Washington" is used as a receiving ship; a gunboat is in reserve, and a monitor and submarine are preparing for the formation of a new submarine division.

At the Philadelphia Navy Yard are the cruiser "Montgomery," 2 destroyers in reserve, and a submarine fitting out; and here also are stationed the ships of the Atlantic Reserve Fleet, as follows: Second line battleships "Idaho," "Maine," "Missouri," "Alabama," "Illinois," "Kearsarge," "Kentucky," "Wisconsin," "Indiana," "Iowa," "Massachusetts;" the armored cruiser "Tennessee," the cruiser "Salem" and repair ship "Panther." As in the case of other ships in reserve, they are from the military point of view valuable for fighting purposes only against ships of an equal or greater age. That it would amount to little less than murder to send American officers and men out in these old ships to fight against a fleet of modern dreadnoughts is a simple truth that everyone should understand. These ships have still a possible use; but to place reliance on them in a time of crisis could never be warranted.

At the Naval Academy at Annapolis are stationed 5 torpedo boats, and at Washington two converted yachts. In the Norfolk Navy Yard the second line battleship "Vermont" is undergoing repairs to the shaft broken while returning from the Mediterranean, and the monitor "Tallahassee" is being used for ordnance experiments. Off Cape Hatteras the first line battleship "Michigan" is proceeding south to join the other ships of the second division at Guantanamo.

Charleston, S. C., is the regular base of the torpedo boats and destroyers in reserve, but only 5 of the former and 3 of the latter, together with 1 submarine, are there at the present time. The rest of the reserve destroyers, 6 in all, are on the coast of Florida engaged in their annual practice cruise for a period of two months. These vessels are manned by only half crews, but are kept on the whole in an efficient condition and are not obsolete. At Key West three new destroyers recently placed in commission are engaged in "shaking down" trials and in torpedo practice preliminary to taking their places with the Atlantic fleet. In Pensacola Bay the second line battleship "Mississippi" is being used in experimental aeronautic work. At New Orleans the monitor "Tonopah" and the second submarine group of 5 vessels are engaged on the annual practice cruise.

Off the north coast of Cuba the "Prairie" and "Hancock," transports, are returning with two regiments of marines from a month of "advance base" maneuvers on the island of Culebra, just east of Porto Rico. This work consists, as the name implies, in landing and fortification drills with the object of establishing a base on a hostile shore.

South of Cuba all the ships of the Atlantic fleet, except those in Mexican and Haitian waters, are engaged in the regular winter practice work—fleet and division drills, torpedo and target practice, boat drills, etc. At Guantanamo Bay are the following ships: Second line battleships "Louisiana," "Kansas," "New Hampshire;" cruiser "Birmingham;" 1 gunboat and 12 torpedo boat destroyers.

A little farther to the west, near Guacanaybo Bay, Cuba, are the rest of the ships of the Atlantic fleet, engaged in similar practice: First line battleships "Wyoming," "Delaware," "Florida," "Utah," 6 torpedo boat destroyers, and one destroyer tender.

The island of Haiti has recently required the almost

constant presence of one or more American ships. At Santo Domingo city is the gunboat "Petrel." Off the coast of Haiti are the battleship "South Carolina," the armored cruiser "Montana," the cruisers "Nashville" and "San Francisco," and the surveying ship "Eagle." The "Montana" was engaged in torpedo training exercises and the "San Francisco" in mine laying practice off the Cuban coast, but both were hurried to Haiti on the outbreak of the revolution there.

On the east coast of Mexico, performing an obvious duty, are the following ships: At Tampico: Second line battleships "Rhode Island," "Georgia," "Nebraska," "Virginia;" cruiser "Des Moines;" and 1 gunboat. At Vera Cruz: Second line battleships "Connecticut," "Ohio," "Minnesota," and cruiser "Chester." Off the coast of Honduras the auxiliary "Hannibal" is engaged in hydrographic surveying. Finally, at Cristobal, the Atlantic end of the Panama Canal, are 5 submarines and their "mother" ship the gunboat "Severn."

I regret that it is impossible in this short article to describe in detail the daily life of the officers and men on board all these ships in both oceans. Ask any of them and they will tell you that there are few moments for idleness, that the many duties require constant mental alertness and physical fitness, and that the man who wants to succeed has in the service to-day a field of opportunity greater than ever before.

Such was the disposition of the American Navy on the 12th day of February, 1914. Briefly, it shows that in times of peace it is as an organization very much occupied with many different kinds of work in many different places; that it is keeping the peace, preventing bloodshed and disorder, governing islands, carrying on scientific work for the benefit of commerce, seeking to rescue castaways, and doing daily a hundred unsung deeds that make it an American institution to be proud of.

But there are other facts to be deduced also—facts based on the premise that the primary object of the Navy is to be ready in the unfortunate event of war. To this end all others must of necessity be subordinated. Just as the police force of a city is of little value in stopping the invasion of a country by a foreign force, so the work of the gunboats and surveying ships and obsolete battleships in time of peace would count for little against the enemy's fleet in time of war. The day is past when it was possible to build, equip and man a frigate in six months. Now a battleship which takes three years to build cannot be taken into an engagement by any kind of officers or any kind of a crew. Many months of thinking, toil and practice are necessary to efficient maneuvering and straight, quick shooting.

A naval war of to-day would not see single ships in action, nor would it see a fleet divided and scattered along the two coasts of the continental United States. A glance at the map shows a part of our activities and interests outside of this continental portion in time of peace. Would we then in time of war be content like the turtle to withdraw into our own shell and see an enemy supersede us in every outlying part, usurp our commerce and destroy our influence as a nation throughout the world?

Yet this will happen just as surely as we can be sure of anything human, if an enemy of the United States obtains control of the seas. And that control is dependent absolutely on one thing—the *preponderant efficiency of the battle fleet*. A thousand gunboats, a thousand harbor-defense submarines or monitors would avail us nothing. Invasion is not what this country has to fear. If the American people are willing to be relegated to the position of a nation unimportant in the great affairs of the world, without influence in commerce, or in the extension of peaceful civilization and high ideals throughout the world, they need no battleships, they need not fear the loss of control of the seas.

Students of naval warfare, naval officers, historians, are as a whole as desirous of peace as any class of Americans; they deplore the struggle of the nations to guard themselves with military preparations, but they realize that we are confronted with a fact and not a theory. The day will come, they hope, when armaments will be limited by international agreement, and they are ready to help hasten that day. But until that day is an assured fact the American Navy must keep the principles of a possible naval conflict always in mind. The efforts of all must be concentrated, as far as possible, on the preparation of the battle fleet. That fleet must at all costs be kept together, for division of forces is fatal; it must be drilled and maneuvered; it must spend good money for target practice; it must contain the best material and the latest devices; and it must in its personnel typify the highest ideals, the greatest efficiency of American citizenship.

Sir David Gill

SIR DAVID GILL, the eminent astronomer, died in London on January 24th in the seventieth year of his age. He was educated at the University of Aberdeen, and spent the time between his twenty-fifth and

thirtieth years in preparing himself to be an astronomer at a private observatory in Aberdeen. During the next three years, 1873 to 1876, he directed the private observatory of the late Earl of Crawford, then Lord Lindsay, and organized the Lord Lindsay expedition to Mauritius to observe the transit of Venus; the observations being undertaken with a view to a redetermination of the distance of the sun, a problem which had a lasting interest for Sir David, and to which he was constantly returning.

From the measurement of the distance of the sun he turned to the measurement of the earth. During the same three years he connected the longitudes of Berlin, Malta, Alexandria, Suez, Aden, Seychelles, Mauritius, and Rodriguez, and measured the baseline for the geodetic survey of Egypt, near Cairo. This was the first step toward realizing what he called the dream of his life, namely, the measurement of the great African arc of the earth on the thirtieth meridian.

In 1880 he proposed the geodetic survey of Natal and Cape Colony, although the project was not carried to completion till sixteen years later. He lived to see the gap in the arc between Rhodesia and the Limpopo filled up and its subsequent extensions through German East Africa, along Lake Tanganyika, toward the Sudan. When that work is altogether completed the great arc will join that of Greece and Struve's great arc, which terminates at the North Cape, and will be the greatest length of the world's surface, 105 deg., more than 6,000 miles, to be measured with mathematical accuracy.

But before this, in 1877, he proposed and carried out an expedition to Ascension Island to determine the solar parallax by observations on Mars, and in 1879 he was offered the post of Astronomer Royal at the Cape of Good Hope. He continued his work along the lines of solar parallax determinations, organizing transit of Venus expeditions to this end.

In 1882 a great comet became visible, and Sir David, with the assistance of an intelligent Cape photographer, succeeded in obtaining some beautiful pictures of the comet, the camera being strapped on the telescope, and not only of the comet, but of the surrounding stars. They were the first really fine photographs of a comet, but they were also the first of the modern photographic star-plates, and from these photographs sprang the whole project of the great Star Map, which still engages the observatories of the world. From this also originated the new method of determining the sun's distance by photographic observations of the minor planet Eros. The spirit which inspired Sir David Gill in his work is best described in an extract from his presidential address to the British Association in 1907:

"Accurate and minute measurement seems to the non-scientific imagination a less lofty and dignified work than the looking for something new. But nearly all the grandest discoveries of science have been the reward of accurate measurement and patient long-continued labor in the minute sifting of numerical results."

He was the recipient of numerous honors, among others being the F. R. S. and K. C. B.

International Map of the World

THE second international conference on the "millennial" map of the world (Carte internationale du monde 1: 1,000,000) met in Paris, December 10th to 18th, 1913, and was attended by representatives of thirty-four countries. Although the fundamental features of this chart were settled at the original conference, in London, many special problems have arisen, and these the second conference attempted to solve. Specimen sheets of the chart have already been prepared by Great Britain, France, Spain, Italy, the United States, Japan, Mozambique, and Sweden. At the London meeting it was decided to include on the chart place-names in common international use in addition to the official names used in the several countries. The Hungarian delegation at Paris endeavored unsuccessfully to have all but the official names eliminated. In the discussion on this subject Prof. Partsch pointed out that the world at large would hardly recognize Jerusalem and Damascus under their official names of El-Kuds and Esh-Shâm, respectively. An additional argument in favor of retaining customary international names is that official names are subject to change with changes of sovereignty (as, for example, after the recent war in the Balkans). It was decided to establish permanent headquarters for the undertaking at London and Southampton. The next conference will be held in Berlin toward the end of the present year.

The "Limequat."—This portmanteau name has been applied to a new hybrid, obtained by crossing the West Indian lime with the kumquat. The tree is much harder than the lime, having withstood the past three winters in extreme northern Florida, where the lime cannot be grown. Fruit was obtained for the first time during the past year, and proved to be much like the West Indian lime in size and flavor.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Feasibility of Utilizing Power From the Sun

To the Editor of the SCIENTIFIC AMERICAN:

I read with much interest an article in your SUPPLEMENT of January 31st, 1914, entitled, "Energy Sources of the Future."

In this article you say: "The capture (of the sun's heat) has been attempted, but on a very small scale and by an ineffective method. The sun's rays have been made to furnish mechanical energy by generating steam in boilers. This method involves great losses, and is incapable of high efficiency."

We have experimented during the past seven years on a very large scale with sun power, and have brought sun power from the ideal stage into the real. Our sun power plant at Cairo has been tested by well known independent engineers, and inspected by many engineers and scientists. Lord Kitchener and Sir Reginald Wingate have watched its working and invited us to put up a similar plant in the Soudan.

Every figure I am going to give is based upon actual results already obtained. There is not a single "should give" or "guess" about it. Sun power is now a fact, and is no longer in the "beautiful possibility" stage. It can compete profitably with coal in the true tropics now.

Sun power has a history something like aerial navigation. Up to twelve years ago it was a mere possibility and no practical man took it seriously. The Wrights made an "actual record" flight and thereafter developments were rapid.

We have made an "actual record" in sun power, and we also hope for quick developments.

The steam boiler has had a hundred and fifty years time for evolution and has reached an efficiency during all this time of only 75 per cent at best.

Our method of generating steam from the sun's rays has had only seven years' time for evolution and has already reached an efficiency of 57 per cent.

Surely this, considering the youth of sun power, is not to be described as "incapable of high efficiency."

Our sun power plant of the vintage of 1911 turned 43 per cent of the heat of the sun which reaches the earth's surface into steam, and our present plant tested during the end of August, 1913, turned 57 per cent into steam, an improvement of 14 per cent in two years' time. This record should certainly encourage us in thinking that during the next ten years we shall be able to reach the 75 per cent efficiency of the best modern steam boiler, and thereafter possibly surpass it.

I will now give a few figures which I stand ready to prove from actual results, as to how safely the human race can lean on the heat and power from the sun's rays, when this heat is turned into steam (surely the most direct and logical way of utilizing it).

These figures are based on the results actually secured at Cairo, Egypt, in latitude 30 degrees north, by no means yet on the equator, where results would still be better, and on what has been done, and not what is going to be done.

For the purpose of my calculation I have taken as a basis the figure given in your article of two hundred and seventy million horse-power continuously throughout the year being equal to all the coal and oil mined during the year 1909 throughout the world.

Now, our sun heat absorbers at Cairo occupy less than an acre of room and develop 50 brake horse-power throughout a ten-hour day. This does not mean that an acre of sunlight is intercepted. The area of sunlight intercepted is only 13,260 square feet, or less than one third of an acre, but it is necessary to place the heat absorber units sufficiently far apart so that they won't shade each other in the early forenoon and late afternoon.

Taking the above actual work of our plant as a basis, it would only be necessary to cover 20,250 square miles of ground in the Sahara Desert with our sun heat absorber units, spaced as wide apart as they now are, to give perpetually the two hundred and seventy million horse-power per year required to equal all the fuel mined in 1909.

This area of 20,250 square miles is practically equal to a square of 143 miles, and its size as compared with the Desert of Sahara is shown by the accompanying map. Surely from this showing, the human race can see that sun power can take care of them for all time to come.

Now the next question your reader will ask is, "How much will it cost to do all this?" Of course the figure will be staggering, being equal to ninety-eight and one half billion dollars (\$98,500,000,000).

An independent engineer with long experience in power plant building in the tropics, estimates the cost of

construction and erecting the 50 horse-power sun heat absorbers referred to above at \$7,600, and by ordinary proportion we obtain the figure given above. Surely this is safe, because in the hundred odd years or so required to totally exhaust our fuel store there will be great developments in sun power.

Having planted the desert with sun heat absorbers at a cost of ninety-eight odd billion dollars, let us look at what we have secured at this enormous cost, and let us see whether we have made a good investment.

We will then have a plant that is worth to us at least as much as all the coal and oil fields in the whole world; because it can perpetually give us as much heat and power as all of the coal fields and oil fields of the world put together, if mined at the 1909 rate. And these are certainly worth very much more than ninety-eight odd billion dollars.

This vast investment would not be made for or by the individual, but for and by the entire human race, and we may safely assume the human race to survive all the coal and oil fields by many thousands of years. Hence, its overwhelming value of perpetuity and its capacity for practically infinite expansion.

The wear and tear and depreciation of sun power plants is no greater than that of coal or oil consuming plants, and another advantage is that the heat is delivered into the boilers entirely free of all cost. All the tremendous costs of mining and transportation and dangers to life are avoided.

To the individual, ninety-eight billions is a stagger-



This map shows how very little of the Great Desert of Sahara would have to be covered with sun heat absorbers to obtain every year a heat value equaling that of all of the coal and oil mined in all the world during the year 1909.

ing sum, but to the human race, particularly if spread out through a period of say 200 years, it is almost nothing.

The human race has expended in coal mines and oil mines and boiler and heating plants many times that sum during the last hundred years alone.

We feel sure the greatest developments in sun power will come when the minds of many thousands of thinkers will be turned in this direction, by the results of our work. We do not expect to do it alone, all we shall now do is to establish sun power as a commercial rival of coal in those portions of the true tropics where coal is very expensive and the sun is very powerful. This will result in enormously increasing the area of cultivatable land, and we will rest at this for the present.

One thing I feel sure of, and that is that the human race must finally utilize direct sun power or revert to barbarism, and I would recommend all far-sighted engineers and inventors to work in this direction to their own profit, and the eternal welfare of the human race.

Tacony, Philadelphia.

FRANK SHUMAN.

The Four-cylinder vs. the Six-cylinder Car

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of January 3rd, page 10, under the heading "The Car of 1914" we find this statement:

"The six cylinder car is predominant. From a small beginning it has swept on until in 1914 it has well nigh carried all before it. It is the prevailing feature of the past automobile year beside which other features pale; but not into insignificance."

We are inclosing a tabulation of the exhibitions at the recent auto shows in New York. While this does not necessarily settle the question, it is at least significant.

Your contributor made no distinction in his article; he bluntly said, "The six-cylinder car is predominant."

We feel at liberty therefore to answer it on the same basis.

While the number of makers producing "sixes" has probably increased by what may look like a big per-

centage, the increase in the actual quantity of six-cylinder cars produced is not relatively large.

There are at least two, and we believe four makers, any single one of whom is producing more four-cylinder cars than all the six-cylinder cars combined.

Now pardon us if we mention the Cadillac. We have already shipped more than 7,500 of the 1914 models.

We would not be surprised if this nearly equaled the output so far of all 1914 six-cylinder cars combined. It certainly exceeds the combined output so far of all six-cylinder cars which are generally recognized as being high grade or even those selling at or above the Cadillac price.

Taking the proposition as a whole, we find according to estimates which are as authoritative as such estimates can be, that the number of cars which have and which will be produced during the 1914 season will be eight to ten four-cylinder cars to one six-cylinder car.

On the basis of dollars and cents, these same estimates show that the selling value of the fours will be two to three times the value of all the sixes.

The fact is, the six does not even approach the four, whether you figure on the basis of the quantity of cars produced or the value of the product.

This letter is dated January 19th, at which time more than 7,500 1914 Cadillacs have been shipped.

Detroit, Mich.

CADILLAC MOTOR CAR COMPANY,

By K. P. DRYSDALE, Advertising Manager.

Dividing United States Coins

To the Editor of the SCIENTIFIC AMERICAN:

I give herewith a solution of the problem in United States coins, given by Theodore L. DeLand on page 117 of your issue of February 7th:

22 coins of.....	\$20.00 each.....	\$440.00
4 " ".....	10.00 ".....	40.00
1 " ".....	5.00 ".....	5.00
4 " ".....	2.50 ".....	10.00
6 " ".....	.50 ".....	3.00
1 " ".....	.25 ".....	.25
1 " ".....	.10 ".....	.10
1 " ".....	.05 ".....	.05
100 " ".....	.01 ".....	1.00

200.....\$500.00

New York city.

FRANCIS J. HALL.

To the Editor of the SCIENTIFIC AMERICAN:

In the correspondence column of your issue of February 7th, Mr. Theodore L. DeLand wants to know how two hundred United States coins can be divided so as to total five hundred dollars. Given below are three solutions:

(1)	6.....	\$20.00.....	\$120.00
	4.....	10.00.....	40.00
	10.....	5.00.....	50.00
	110.....	2.50.....	275.00
	16.....	.50.....	8.00
	18.....	.25.....	4.50
	22.....	.10.....	2.20
	4.....	.05.....	.20
	10.....	.01.....	.10
	200.....		\$500.00

(2)	6.....	\$20.00.....	\$120.00
	6.....	10.00.....	60.00
	8.....	5.00.....	40.00
	110.....	2.50.....	275.00
	2.....	.50.....	1.00
	2.....	.25.....	.50
	20.....	.10.....	2.00
	26.....	.05.....	1.30
	20.....	.01.....	.20
	200.....		\$500.00

(3)	2.....	\$20.00.....	\$40.00
	8.....	10.00.....	80.00
	10.....	5.00.....	50.00
	130.....	2.50.....	325.00
	2.....	.50.....	1.00
	4.....	.25.....	1.00
	20.....	.10.....	2.00
	19.....	.05.....	.95
	5.....	.01.....	.05
	200.....		\$500.00

Kingston, N. Y.

E. A. VIGES.

The Earthquake Felt at Troy

To the Editor of the SCIENTIFIC AMERICAN:

I write to report an earthquake at Troy, N. Y., on February 10th, which lasted from 1:30 P. M. to about 1:31 P. M. The quake was strong enough to cause loose articles to rattle and was distinctly noticeable to a person sitting down. The vibration was much like that caused by an engine on a boat.

Troy, N. Y.

JOHN WILLIAM BACON.

A Triumphant Struggle With a Beetle

How the Coconut Trees of Samoa Were Saved

By H. J. Moors

THE value of coconut products has increased at a wonderful pace during the past five years, and the acceleration during the past two years has been quite phenomenal. This is chiefly owing to new methods of treatment and manipulation as applied to copra.

Cocconut oil when made from the best materials is clear white and has a sweet, agreeable, nutty flavor. It is now possible to refine, clarify, flavor, and congeal this substance into a very useful butter, and numerous factories in Europe and also some in the United States have worked up such profitable business, that some of them last year declared dividends exceeding 40 per cent.

The demand for first-class copra is continuous and increasing, and the supplies though very large are still far below the demand, which every month enhances.

Many planting companies have been formed in Great Britain and in Germany, and very large groves of cocoanuts have been set out in many parts of the tropical world, but even if all of these were in fullest bearing, their output would hardly depress the market, so strong is the demand for this edible oil.

The cocconut tree grows only from the mature nut, which is planted about six inches in the ground and not entirely covered up. Six years later the growing tree begins to deliver its fruits, a little at first, then more and more, until the twelfth year, when in good situations it delivers from 70 to 100, even up to 150 nuts per annum, each producing from one third to one half pound of dry copra.

About 50 nuts are planted to the acre and these give from one third to one half ton of

They have done immense injury all over the tropical world, especially in Malaysia, Madagascar, Ceylon, the Philippines and Cochin China. About four years ago they first appeared in German Samoa, but little notice was at first taken of them. Later on, their destructive

work attracted attention, and then alarmed the foreign residents.

Rewards were offered for the live beetles, and for their larvae, and after some \$10,000 was paid out in a few weeks, the government had to change its policy, and to compel all natives to hunt beetles for their own protection, while the foreign residents contributed liberally in cash for the abatement of the nuisance. Of course, such efforts had their effect, but the plague seemed to spread fast in all directions, before the prevailing wind. In due course fully 20,000 trees were killed outright, and probably ten times as many are still beetle-infested and many will die.

The beetle lays its eggs frequently, and always on the ground, in the midst of rotting rubbish, if possible, rotting wood being a favorite place. It was found that if shallow pits were dug, say six by six, and a foot deep, and these filled up six or eight inches with rotten stuff, and a heap of cocoa shells piled on top, and the whole covered up with the soft soil that was first taken from the pit, a first-class beetle-breeding place had been provided.

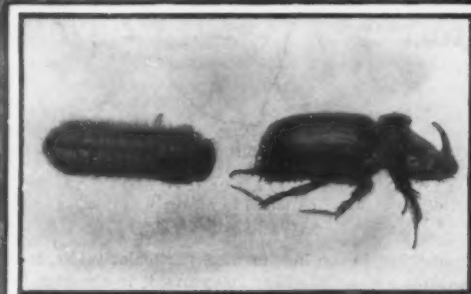
It is likely that the smell of the fermenting and decaying cocoa shells drew the mother beetles from all directions. At any rate, they came to these "Tumus," and laid their eggs, and every ten weeks these "Tumus" were opened, and the larvae and loose eggs were taken out and scalded. By this means probably millions of beetles never reached the harmful stage. These efforts were of great value, but something more was wanted, for the plague increased and many acres of fine cocoanuts were



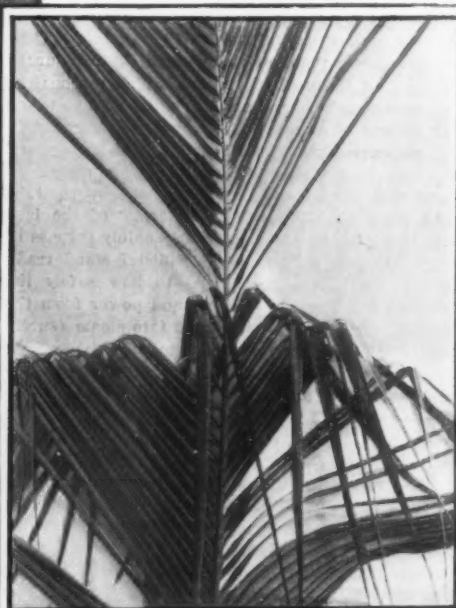
Grove of cocoanuts taken from a balcony in Apia. These were all in a fair way of dying, but were saved by natives climbing them and removing the beetles with sharpened wires. Afterward the hunt for larvae in this neighborhood become so keen that the trees were not attacked again.



Old coconut leaf branch, showing the tunnels through which the beetles entered.



Cocconut or Rhinoceros beetle and larva.



Showing the beetles' work at close range.



Finis.

copra which is worth to-day in the United States and in England about \$160 per ton.

Fine grasses are grown beneath the trees in some parts, and great herds of fat cattle are raised for consumption.

As the cost of manipulating a cocconut plantation is very little when it is in full bearing, and stocked with cattle, it can well be conceived that such property is highly valuable, and is held at prices ranging from \$200 to \$300 per acre.

About 50 years ago, a vicious beetle appeared in Madagascar, and attacked the crowns of the trees, boring deep galleries right through the leaf stems into the heart of the cabbage. When these insects confined themselves to attacking the tree pretty high up, they did no very serious damage, though they ruined its graceful appearance. If they attacked low down, or deflected their course downward after entering, then they very frequently killed the trees. These insects range from an inch to an inch and three eighths in length; they are very thick and are armed with a formidable horn, from which they take their name.

devastated. At last an experienced entomologist was sent for, and young Dr. Frederichs came out from Berlin. Month after month the residents of Samoa impatiently awaited results.

Feeling that more scientific help might perhaps find a way to limit the evil, private subscriptions were set afoot and Dr. Doane, of the Leland Stanford, Jr. University, was induced to come to Samoa during his summer vacation, and he and Dr. Frederichs worked in complete harmony.

But as Dr. Doane's stay was limited to seventy days, he had not sufficient time to do very much.

During the investigations, Dr. Frederichs noticed on one single beetle larva two small brown spots on its back; in a few days these coalesced and became one, and the larva sickened. Minute observation showed that it had been attacked by an island fungus. Other larvae were confined with it, some twenty or more, and several of these were soon infected. But for many weeks the

(Concluded on page 186.)

"White Art" and the Automobile Leap at the Hippodrome

Phosphorescence by Irradiation

THE New York Hippodrome far outclasses its London namesake, and in the past nine years nearly 27,000,000 people have passed its doors. Each year presents novelties which are of great interest, and on two other occasions we have shown some unique features. This year two new acts are given which are certain to interest all readers of the SCIENTIFIC AMERICAN. Through the courtesy of Mr. Arthur Voegtlin, who has been responsible for the remarkable scenic effects in this vast house for many years, we are enabled to present authentic pictures of "white art," posturing as we might term it, in contradistinction to "black art," where the actors are clothed in somber mantles and perform on a dark stage. We might go a step farther and call it "luminous white art," for the girls would not give the realistic ghost-like thrills when they walk down the aisles if they did not wear phosphorescent garments.

It might perhaps be well to glance for a moment at the principles which underlie all luminous preparations. A curious circumstance is that light from what we call phosphorus is not true phosphorescence at all, because it is accompanied by quite appreciable heat and is caused by slow combustion. It proceeds from the vapor of the phosphorus undergoing slow combustion. The term phosphorescence would best be applied only to cases in which no heat is appreciably evolved and no oxygen appreciably absorbed. The "luminous paint" phenomena belong to what is known scientifically as "phosphorescences by insolation or irradiation," giving out light in the dark after exposure to sunshine, the light of burning magnesium or the electric arc light. It appears that when certain rays of light fall upon a phosphorescent substance a change is caused and the rays are transmuted into others. In other words, the storage battery might be cited as a similar instance where chemicals are used to store up a potential force. The light which is stored in the phosphorescent substance is vitiated and in time exhausted when exposed in the dark.

In the Hippodrome during a "spooky" act the lights in the house suddenly go out and down the aisles come girls clothed entirely in white luminous garments, even to masks, headgear and gloves. They move up and down the aisles gracefully posturing like dancers to the mystification of the audience. People often put out their hands to touch the ghosts to see if they are real. After a minute or so the girls retire and assume their long black cloaks and they would hardly be noticed in the foyers. To be successful the house must be as dark as "Chevreul's black;" this is accomplished by the ushers momentarily masking the exit lights. The effect is most mysterious, as will be seen by our engraving.

A short time before the act the girls go to dressing rooms on the orchestra and balcony levels, and assume the luminous garments. Their faces are completely masked and they wear smoked goggles to protect their eyes while their garments are being charged. About 20 minutes are required to fully saturate the luminous coating. They turn around and bathe in the light so that every portion of their clothing is impregnated by it. Afterward comes the "cue" and the electrician turns off the switch and the girls move to their stations, where the ushers divest them of their cloaks, and they proceed down the aisles. It is a very pretty conceit and is exceedingly well done.

In the next scene we have the Grand Cañon of the Colorado River portrayed as well as it can be by the scene painter's art. The stage is divided into two parts by a great proscenium arch. To the front of this

Then came the call for volunteers for an actual test, for the use of dummies would have proved nothing. Finally one of the engineering staff, a man of extraordinary nerve, stepped forward and offered to pilot the machine. With bated breath the technical staff waited to see whether he would land in the tank or in G, 7 and 8. Fortunately he got clear and jumped at the right time and the trick was turned, but a new automobile was required for the next trip. After about five automobiles were converted into junk, a special property auto was made of angle iron and it still stands the twice-daily ordeal. The run-way is banked so as to prevent the wheels leaving the track.

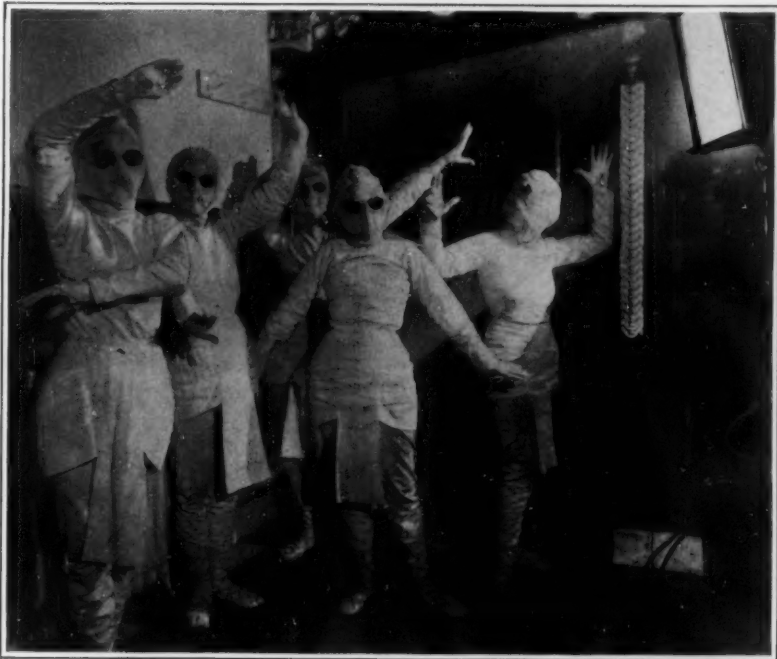
The car has weights secured in the back and there is a hump at the end of the track which serves to throw the car up so that it turns a complete somersault, landing in the water bottom side up. The tank is filled to 14 feet for this act and a tell-tale makes sure that the men will land in deep water when they jump. The men swim under water and are seen on the surface as the curtain rises (it does not lower at the Hippodrome).

Some Well-packed Eggs

THE somewhat unusual feat of shipping eggs from one side of the world to the other was recently accomplished when a consignment from Russia arrived at Pittsburgh without a single one being cracked or broken. This shipment consisted of fifty cases, or 6,000 dozen, and originated at Warsaw. The eggs were carried by boat to Labava, a distance of 1,400 miles, thence 1,500 miles by rail to Rotterdam, about 3,000 miles across the Atlantic to New York and 500 miles by rail to Pittsburgh. The distance traveled was about 6,400 miles, and the eggs were drayed on a number of occasions, transferred from boat to rail and vice versa. The cases were stood on end and with chains wrapped around three or four cases in a bunch they were lowered into the hold of the vessel and, in general, were subjected to much rougher handling than is encountered by shipments in this country.

The cases in which these eggs were packed were 70½ inches long, 22 inches wide and 9½ inches deep, and were made of pine. The ends were ¾ inch thick and the top, sides and bottom ½ inch, the strips being 6 inches wide. In packing the eggs the case was laid flat and the packer took shavings and made a cushion, which was about 1 inch thick when packed close. On top of the cushion the eggs were placed in 10 rows of 18 each, or a total of 15 dozen in each compartment layer. He then placed another cushion of shavings of the same thickness on top of this and then another layer of eggs, repeating the process until the filled case contained four layers. It is stated that the case and the shavings can be provided more cheaply than four of our standard cases with fillers of the same combined capacity.

A Monument to Capt. Robert F. Scott has been erected on the Col du Lautaret, France, in the Alpine garden of the University of Grenoble, where Scott spent some time mountaineering in 1908, in preparation for his Antarctic expedition. The monument is in the form of a polar cairn, ten feet in height, and bears a suitable inscription. It was erected by Scott's French admirers, on the initiative of Dr. J. B. Charcot.



Charging the luminous garments with light emanations from an electric arc light.



"White art" weird ghost girls pass down the aisles dressed in phosphorescent clothing.

is the "apron" with its platforms covering the unique feature of the Hippodrome—the tank. While the tank is being filled, a short operation, the scene shifters are bringing out and lashing together three sections of roadway 70 feet long, which extends from the up-stage end to the edge of the tank. These elevated sections are strongly braced to stand the shock of the automobile in its spectacular descent. Mr. Voegtlin tried countless experiments with models before the exact angle of the track was determined. It was found by trial that the wheels need not be fixed and that the machine could be steered like an ordinary automobile.

The Heavens in March

Is Interstellar Space Transparent? Are There Dark Nebulae?

By Henry Norris Russell, Ph. D.

AMONG the recently published astronomical papers have been some of great interest which deal with the question whether interstellar space is transparent. We ordinarily assume that the light of the stars, even though it may have hundreds of years to travel before it reaches us, suffers no further loss in its passage than that which naturally arises from the spreading out of its waves over an ever-widening area. But within the last few years, this hypothesis (for it is no more) has been called in question by several investigators, and for different reasons.

If interstellar space was absolutely empty of matter, we know of no reason why light should be absorbed in passing through it; though he would be a bold physicist who claimed that we know enough about the ether to be sure that no such absorption could take place. But it is very improbable that interstellar space is so absolutely barren. There may be a good deal of matter floating about in it, perhaps in the form of solid lumps or particles of different sizes, perhaps as separate molecules of gas, and such matter, if it exists, would make the space within which it lay imperfectly transparent, acting like a very thin mist or fog.

The behavior of such absorbing material would, however, be different, according as it was composed of relatively large particles, or of material of molecular fineness. In the first case, it would absorb light of all wave-lengths to the same degree as a dust-cloud in our atmosphere does; but in the second, it would absorb blue light much more strongly than red, like our atmosphere itself, whose absorption in clear weather is largely due to the scattering of light by the air molecules.

Within the last few weeks very convincing evidence in favor of the existence of absorption of both these kinds has been published. Prof. Barnard, following the same line of argument developed in earlier papers, calls attention to some of the remarkable black spots in the Milky Way. One in particular, in Sagittarius, appears as an oval patch, about half the apparent diameter of the Moon, in the middle of a dense star-cloud. All around it the stars strew the sky so thickly that on the photograph their images almost overlap; but within this small region there is blackness, except for two isolated stars. A mere glance at his photographs shuts one up to two explanations: either there is a hole through the star-cloud through which we see into the abyssal night beyond, or there is an opaque body in front of the star-cloud, which hides part of it.

The chief difficulty about the first explanation is that the dark hole is very small compared with the cloud, and has sharp edges. If the star-cloud is about as thick as it is long or broad, which seems natural to suppose, the hole through it, to look as it does, would have to be a sort of long narrow tunnel, pointing right at us. There might perhaps be one such affair in the sky; but Prof. Barnard gives particulars of another similar black spot, equally dark, but still smaller, in the same region of the heavens, which, as he says, looks in the telescope "like a drop of ink in the sky." That there should be two such tunnel-like holes through star-clouds, in the same part of the sky, and both pointing right at us, passes belief.

The alternative explanation offers no such difficulties; but the existence of huge and practically opaque regions in space, whose diameter may be a large fraction of a light-year, if not more, is so startling an idea that it needs a good deal of proving. But Prof. Barnard has greatly strengthened this idea by careful visual studies of the first of these dark regions with the great Yerkes refractor. On a clear night, with fine seeing, he finds that in this region the sky is "dull" compared with the surrounding regions, and that on one part of the area it is very faintly luminous, showing that a very faint but real object occupies the place of the "dark hole." There are a number of other regions where "dark lanes" seem to be connected with visible nebulosity, but the new one is one of the most remarkable, and the evidence is now so strong as to convince most astronomers that regions of absorbing matter—"dark nebulae"—probably exist between us and the Milky Way. The few isolated stars in the dark areas

are presumably on the nearer side of the "dark nebulae" which seem sometimes to be almost perfectly opaque.

But these absorbing regions, though almost incredibly huge, are isolated; and we can only detect them in case the great star-clouds of the Milky Way afford a luminous background on which they are projected. If the whole heavens were filled with a uniform haze of the same sort, making all the stars seem fainter than they otherwise would, we would be unable to detect it, because of its very uniformity.

The chance of detecting general absorption of this sort becomes much better, indeed, the problem only becomes soluble at all with our present means, when the absorption is of the second kind, increasing from the red to the violet. In the presence of such absorption, a star, if we could remove it to greater and greater distances, would look redder and redder, just as the sun does as it sinks in the west, so that its light has to traverse an ever-increasing thickness of air.

We cannot actually remove a star to varying distances; but, on the same assumptions, we can reason-

here; but a recent paper by Dr. Adams of the Mount Wilson Observatory seems to have surmounted the difficulty.

A number of pairs of stars were selected, the two stars of each pair being alike in spectrum and similar in apparent brightness, and the spectra of each pair were photographed side by side on the same plate and developed together, taking care that the stars were at the same apparent altitude in the sky at the time of the exposures, so that the absorbing action of our atmosphere should be the same for the two. One star of the pair is chosen, if possible, from the now extensive list of stars known from direct measures of parallax to be near us; the other is selected on account of its very small proper motion in the heavens, and is therefore presumably distant. If this star is really farther away than the other (which is probable but not certain in the individual case, but sure to hold true on the average), and violet light is absorbed more than blue light in passing through space, the spectrum of the remoter star should fall off in intensity toward the violet more rapidly than that of the nearer star. Such an effect is shown in fourteen out of the twenty pairs so far photographed, and in some cases the effect is very conspicuous. There is not a single example of the contrary effect. Since all disturbing factors have been carefully eliminated, it seems clear, even from this relatively small amount of evidence, that the distant stars actually appear redder than the nearer ones.

As we have already remarked, this might be because they are of greater real brightness, not because they are farther away. But a second series of plates is now being taken at Mount Wilson, in which the stars to be compared are similar in spectrum, but of very different real brightness, while at about the same distance from us. For such stars the effects of space-absorption would be the same, but the influence of differences in actual brightness would come in to their full value.

The few photographs so far taken for this purpose seem to show that the effect of differences in actual brightness is small, if perceptible at all. If this is confirmed by fuller study the existence of absorption of violet light, to a greater extent than blue, during its passage to us from the remoter stars, will apparently be satisfactorily proved.

It will not improbably be possible to estimate how great the effect is for every hundred light-years of distance; and in this case it will become practicable to estimate the distances of very remote stars, now too great even to guess at, by finding out how much redder they are than near-by stars of the same spectral type.

The Heavens.

As our map shows, the most brilliant region of the sky is now well down in the west. Taurus, Orion and Canis Major lie in a horizontal line, not far above the horizon, and above them are Auriga, Gemini, and Canis Minor. This small region of the sky contains five stars brighter than the first magnitude, and nine more between the first and second magnitudes. At the present time, Mars and Saturn are both within its borders and these too appear brighter than the first magnitude, making the western sky unusually well lighted.

The southern heavens, on the contrary, are very dull. Leo, high, near the zenith, is conspicuous, but the immense constellation Hydra, lower down, contains but a single bright star, and there is practically nothing below this.

In the southeast is the small, but conspicuous group Corvus, whose two uppermost stars point straight toward the still brighter star Spica, in Virgo. Due east, at a moderate altitude, is Arcturus, with his fainter companions in Boötes. Below on the left is the semi-circle of Corona Borealis, and on the northeastern horizon Hercules is rising.

The Great Bear stretches northward from the zenith to the pole. Lower down, east of north, are Draco and Ursa Minor, while Cassiopeia and Cepheus are on the northern horizon.

(Concluded on page 187.)



NIGHT SKY: MARCH AND APRIL.

ably expect that, other things being equal, the more distant stars will look redder than the nearer ones.

Many efforts have been made to test the theory in this way; but it is surprisingly hard to make it certain that "other things" are really the same for the two stars, or two groups of stars, compared. It is easy enough to get an accurate measure of the color of any star by photographing it, first on an ordinary plate with violet light, then on an isochromatic plate with yellow light, and comparing its brightness in both cases with some standard star of known color. But when this was done, it was found that stars showing different spectra were very different in color. So we must confine our investigations for the detection of "space absorption" to stars of exactly the same type of spectrum, and then must pick out near and remote ones for comparison of color. But we must choose stars of about the same apparent brightness, for a long exposure on a faint star may not, and often does not, give exactly the same result for the color as a short exposure on a bright star; and if two stars, one near us and one very far away, look about equally bright to us, the remoter one must of course be really very much the brighter of the two. Now it may be that a very bright star showing a given kind of spectrum tends to be redder, or for that matter, bluer, than a faint one of the same spectrum; and before we can be sure that we have evidence of the absorption of light in space, we must prove that our results have not been vitiated by some such difference in the color of bright and faint stars.

Several previous attempts have met with trouble

How's the Weather Up There?

By C. L. Edholm

BALLOONS sent up eighteen miles to report on weather conditions bring back the answer that it is rather chilly, 85 degrees below zero, to be accurate, which is some frost even for Medicine Hat.

As it happens, this report comes from a region nationally advertised for its mild climate, from Southern California, but the famous Pacific Coast climate is not claimed to extend indefinitely straight up.

Of course, no one was commissioned to ascend to an altitude of eighteen miles, or anything like that, merely to secure a weather report, but some very trustworthy messengers of aluminium and steel were sent up instead, delicate recording instruments inclosed in water-tight cases and carried aloft in wicker baskets by twin balloons. A series of twenty-three balloon weather soundings has just been completed at Avalon, Santa Catalina Island, off the California coast, by observers of the Weather Bureau, and the way they got results was unusual and exceedingly ingenious.

The meteorograph, in its wicker basket, was suspended between two balloons of pure rubber, which were inflated with hydrogen gas and set adrift. On leaving the ground, these spheres had a diameter of 8 to 10 feet, but as they ascended, the air pressure decreased and the gas continued to expand until at an average altitude of fifteen miles the gas pressure from within became greater than any rubber could endure, and one of the twin balloons would burst. The weight of the instrument and basket was an easy load for two balloons, but it was too heavy for one alone to support aloft, so following the explosion of balloon number one, the second would slowly trail earthward, or seaward, and the meteorograph and the rubber sphere above it would float about on the waves until sighted by some passing vessel or fishing craft, or until the tides washed it ashore.

This seems as precarious as "casting bread upon the waters" in the hope of "return after many days," but as the Government allows a reward for the return of the instruments, the voyagers along the coast are alert for them. Before the entire twenty-three ascensions had been made, there were three recoveries, and it is probable that for months the announcement of further finds will be made. Those picked up during the recent tests were sent to Avalon, but the rest will be shipped as fast as received to Mount Weather, Va., to be opened and examined by the scientists stationed there.

When inflating the balloons, they were filled with enough gas to carry them as high as possible, and no variation in the amount of gas was provided that would cause the explosion of any one sphere before the other. This was left to chance, as the difference in the strength of the envelopes was sure to prevent simultaneous rupture.

The men conducting the experiments on Santa Catalina Island are all well known experts in their chosen work. Mr. B. J. Sherry has spent many years in research, and was placed in charge of the tests. His colleagues are Mr. W. R. Gregg, senior research observer at Mount Weather, and Mr. Paul Hathaway, the odolite expert, who traces the course of the balloons by means of his transit-like instrument. The photograph which shows the balloons in the air, just after leaving the Avalon golf links, as well as the detail views of the instruments, were taken by Dr. Ford A. Carpenter, weather forecaster at Los Angeles, who kept in close touch with the experiments.

When the aerial strays are safely gathered at Mount Weather, the work will be far from complete. The meteorograph records are traced by three

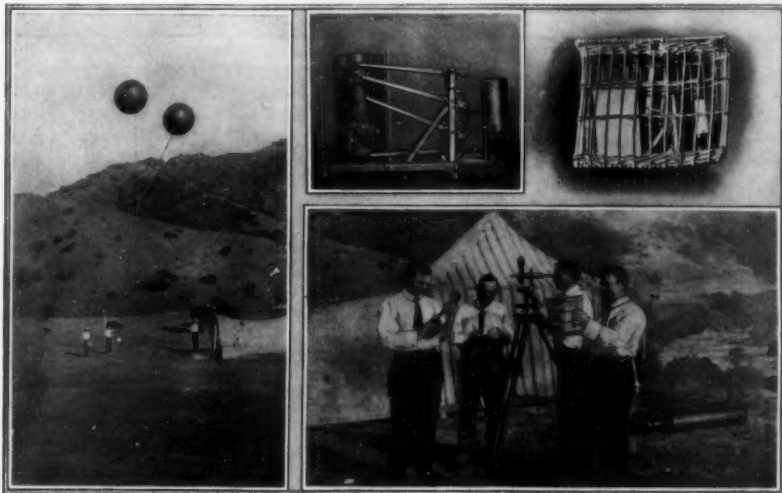
needles upon an aluminium cylinder blackened with camphor smoke. Altitude, humidity and temperature are thus recorded, but very elaborate computation will be required on each record.

From the salt-encrusted instruments recovered and

temperature did not show more intense cold; on the contrary, it was just a trifle less chilly. This indicates a belt of even temperature of unknown thickness above that part of the earth, extending above the so-called "storm zone," which is within the eight-mile limit.

Above this zone the air currents of Southern California seem to have a steady trend from the southwest to the northeast, while below this the currents are variable; generally from the west.

It is hoped that permanent stations in the West and Northwest may be established for balloon soundings at great altitudes, as a prolonged observation of the results would undoubtedly throw light on many a problem that has puzzled the weather man, and enable the forecasters to predict with far greater accuracy the approach of storms and the other phenomena that are of such direct and practical importance to the average man.



Recording weather conditions at high altitudes with sounding balloons.

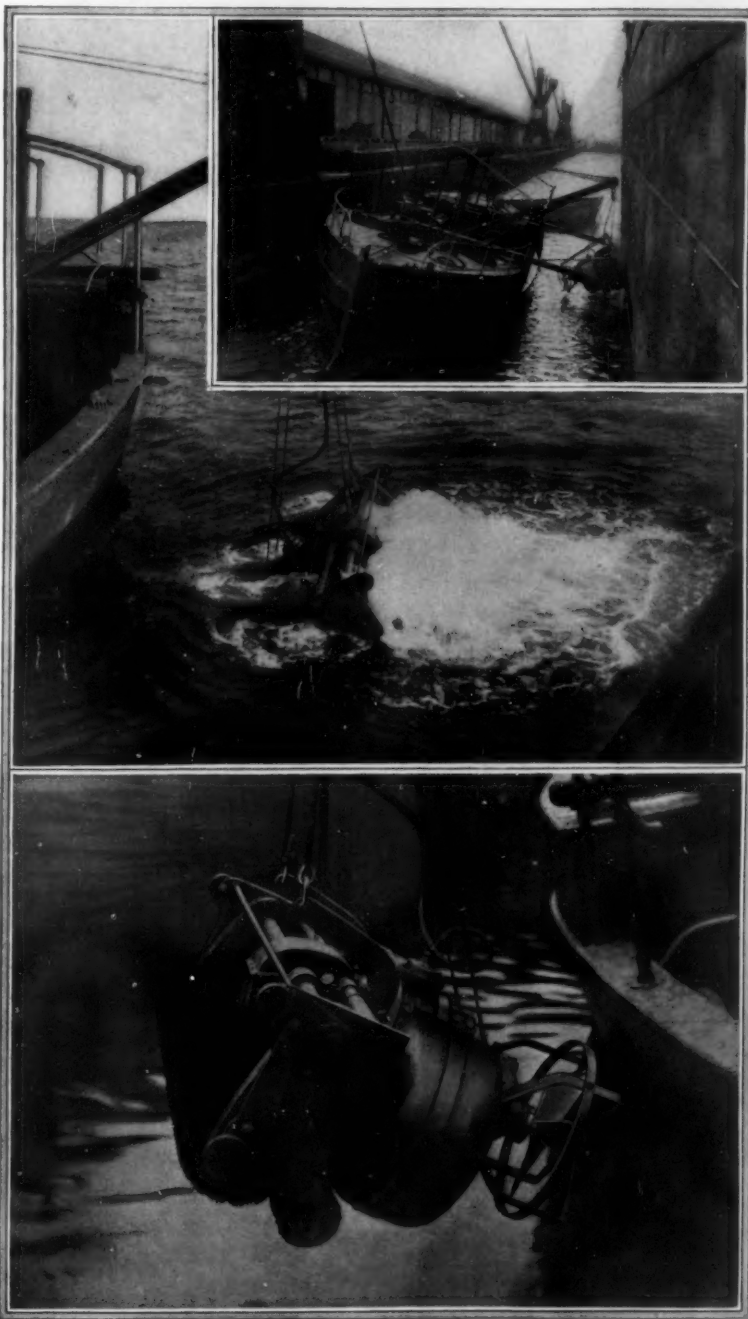
sent to Avalon, it was found that the air grew steadily cooler up to an altitude of about eight miles. There the extreme of 85 degrees below zero was recorded, but though some of the balloons went much higher, the

time enables the operation to be achieved quickly, cheaply, and without the necessity for dry-docking. He realized that the cleaning of the hull could be carried out while the vessel was discharging and re-loading and not at all delaying her.

The cleaner comprises a flat-bottomed barge thirty feet in length by twelve foot beam, which draws from two and one half to three feet of water. It is fitted with a special winch, submersible brushing gear, and the necessary electric generating plant. A crab winch fore and aft suffices for manipulating the mooring ropes. There is also a propelling motor for driving the barge, which is thus able to move under its own power at about five knots an hour.

The cleaning gear consists of a brass and gun metal frame in which is mounted the brush, electric motors, and the propeller, the last constituting an outstanding feature of the invention. The brush is longitudinally mounted upon the front side of the frame. It is five feet in length by twelve inches in diameter, and is fitted with two and one half inch fiber bristles. Behind the brush is a three-bladed phosphor-bronze propeller. Between the brush and its propeller an electric motor is fixed for driving both the brush and its propeller. The motor is of a special submersible type and receives current through a three-core rubber-sheathed cable. The brush is driven by chain gearing from an intermediate shaft, which itself is driven through worm gearing by the motor. The latter also drives the propeller.

In operation the barge takes up a position alongside the vessel to be cleaned, and is made fast fore and aft. The brushing gear is lifted overboard by means of the winch and derrick, and is lowered into the water. The brushing motor then is started. The action of the brush propeller, combined with the manner in which the gear is slung overboard, forces the frame gearing and revolving brush hard against the vessel's hull, and the propeller keeps it well up to its work. While running, the gear is gradually lowered in a vertical direction, still pressing against the hull, to such a depth as the steamship's draft may require. The gear is then raised to the surface, the brush still rotating, the barge is moved forward a distance of four feet, and the operation repeated. It will thus be seen that the hull is cleaned in vertical strips, and although the latter are five feet wide—the length of the brush—by moving the barge forward only four feet at a time, an ample margin is provided to insure complete overlapping of adjacent cleaned strips.



A machine that scrubs barnacles from ships' bottoms.

The Motor-driven Commercial Vehicle

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The Editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles.

The Motor Truck in Snowbound Streets

THE seventh annual automobile number of the SCIENTIFIC AMERICAN, published in January, 1905, had on its cover the picture of an automobile in a snow-storm. This was so unusual a scene as to create a sensation. Up to that time the motor car had been looked upon as a pleasant weather vehicle, to be stored in the garage at the first fall of snow. Little did we think then that within a few years it would be our mainstay in winter storms, not merely for passenger service, but for the transport of merchandise; that when the ordinary wagon could barely be kept moving with the aid of two and four extra horses, large motor trucks bearing many times the load of coal or milk or other indispensable commodities would pursue their powerful course despite the obstructing snow.

We in New York had almost forgotten that the motor truck was so efficient until we were suddenly overwhelmed the other day by a heavy snowstorm—the first of any consequence in over a year. At the first opportunity we sent our photographer out to record some of the difficulties of vehicular traffic, and to show how motor trucks were getting on under such adverse conditions. The manner in which motor vehicles plowed along despite the heavy handicap was very gratifying. To be sure, there were many sections which even they could not traverse, but by comparison with the work of the horse that of the motor was remarkable.

The poor horse is not provided with a reduction gear which will enable him to use his powers to better advantage. Unfortunately, he is a direct connected motor and there is no way of easing up the work without the use of tackle, which obviously is impracticable in congested streets.

Although a motor may be powerful enough to turn the driving wheels, under any conditions, this does not necessarily mean progress, for the wheels may slip, and therein lies a weak spot in driving motor vehicles through snow. Without tire chains or their equivalent progress is almost impossible. In some situations even tire chains do not furnish sufficient grip.

Another weakness is to be found in the differential which permits one wheel to remain stationary while all the power of the engine is expended in idly spinning the other. Formerly electric vehicles used two motors, one for each driving wheel; but the advantages of a single motor have led to its almost universal adoption despite the necessity of employing a differential gear; and so now the majority of electric trucks are in the same class with the gasoline truck as regards this particular weakness.

The photographs shown on the accompanying page were, with one exception,



Faithfully at work in a blizzard "tie-up."



Breaking a path through deep snow.



Motor delivery wagons proved invaluable to the department store.



Pursuing its powerful course despite the storm.



The snow did not stop the delivery of pianos.

taken on the streets of New York and Brooklyn. The one exception is that of a five-ton coal truck which did remarkable work in Cleveland, Ohio, during the blizzard of last November. It happened that this truck had been promised to a coal company in Cleveland for a demonstration during the worst days of the storm, and although vehicular traffic throughout the city was practically at a standstill, this truck started out Monday morning with an inexperienced driver and worked steadily without stop until 3 A. M. Tuesday. Two hours later the truck started out again and worked until 3 A. M. Wednesday, and then beginning again at 7 A. M. Wednesday it worked until the afternoon, when it started hauling groceries. During all the working hours the engine was kept running continuously and little time was spent in loading and unloading. While the truck was in service the coal company tried to use its teams as well, but found it impossible to get around with four and six horses to a wagon. Altogether during the three days of the storm it ran about five thousand miles and used up over sixty feet of tire chain, the action of the snow causing the links to twist and break off. A better record for a motor vehicle could hardly be desired.

Steel vs. Wood for Motor Truck Wheels

By Elmer J. Lamb

A RIGID and exacting series of tests has just been completed in the school of mechanical engineering at Purdue University to show the relative efficiency of steel and wood as material for motor truck spokes. In the investigation wooden wheels constructed according to the specifications of the Society of Automobile Engineers and steel wheels of standard dimensions, but of steel stampings, were used. The tests were conducted under the direct supervision of Professors L. V. Ludy and H. H. Schofield. They included not only tests to which a wheel would be subjected under actual road conditions, but also such as would show the ultimate strength in every detail. The wheels were subjected to four tests, and in each the steel wheel built for a load of only a ton and a half proved superior to the wooden wheel built according to 2-ton truck specifications. The steel wheel was built entirely of steel with the exception of the rim, which was built of wood, so that it might be available for any kind of a tire. The rim and the hub were connected by a pressed steel web fastened together with rivets.

The tests brought out clearly the present difficulty experienced by most manufacturers in obtaining a grade of lumber sufficiently uniform for the manufacture of automobile wheels. The present scarcity of good material makes it possible that

one spoke may be slightly inferior, thus reducing the strength of the assembled wheel. Each test was continued until the wheel gave away or until the capacity of the testing machine had been reached. In the case of the wooden wheels, failure was always apparent in one place, thus showing slightly defective material, although as a whole they fulfilled the specifications. The steel wheels when tested beyond their capacity gave away more uniformly.

The first experiment corresponded to the twisting force or torsion of the hub on a wheel mounted upon the driving axle of a truck traveling under a load. The load was applied to the rim of the wheel and the rim held stationary, while a force was applied to the hub so as to twist it. The force was applied in the manner that the drive of the motor would be applied under actual road conditions.

The second test consisted of holding the wheel stationary on the axle and applying a load to the rim on one side, corresponding to the force exerted on the wheel of a truck, skidding and striking a curb or other obstruction.

In the third test a wheel was placed in a vertical position on its rim in a static testing machine and the load applied directly across the diameter, the load being increased to determine the strength of the wheel. Finally, the wheel was supported by the rim on two sides, lying horizontal, and the load was applied to the hub. According to the university authorities there is no record at the present time of any wheel's being submitted to this test in the past.

Minnesota Road Patrol System

MINNESOTA'S designation of 11,000 miles of arterial roads as the State road system has already done much to advance the land values and place the "North Star State" among the first rank as regards road improvement. In 1914 Minnesota will spend \$2,500,000 for roads and bridges, and will inaugurate a system of road patrols for the maintenance of the State roads. Nearly 1,500 patrolmen will be assigned to five and eight-mile sections of the State highways, and will be held responsible at all times for the condition of the roads. The plan was originated and adopted at the request of State Highway Engineer G. W. Cooley. Twenty per cent of the one mill State road tax and a similar amount of the county appropriations for road work must be used for maintenance under the law passed a year ago. This makes available \$500,000 for the new patrol system.

Motor Truck Notes and Queries

D. L. C. writes: "The 30 horse-power motor of my two-ton truck seems to lose power on a hill and to pound and knock, even though the spark is well retarded. Another business man in town who operates the same kind of a truck tells me that there is probably an accumulation of carbon in the cylinders, and that this should be removed if I would obtain satisfactory results from the motor. It is quite probable that this should be done, but I cannot spare the truck for the several weeks that would be required to overhaul the engine. Is there any short-cut by which I can overcome this difficulty, and how may I best avoid such trouble in the future?"

A. From the symptoms that you have given, it seems probable that your friend's diagnosis is correct, but it is hardly necessary to dismount the motor entirely for the removal of the offending carbon. By a new process, it is only necessary to remove the valve caps and introduce a certain form of blowpipe into the combustion chamber. This blowpipe is connected with an oxygen tank, and when united with the carbon in the cylinder, forms an ignitable mixture that will burn the cylinder and piston heads absolutely clean of the carbon deposit. The flame is automatically extinguished as soon as the carbon has been burned, and therefore the heat is not sufficient to injure the interior of the motor. It is advisable, however, that

the piston should be at the top of its compression stroke in the cylinder before the mixture is ignited, for the heat would be liable to scorch the smooth surface of the cylinder walls over which the piston passes. The operation requires but an hour or so for the removal of carbon from all four cylinders, and the engine is cleaned more thoroughly than would be the case were the surfaces scraped. One of the most satisfactory methods of avoiding the accumulation of carbon in the cylinders is to pour a couple of ounces of alcohol through each priming cup or spark plug opening when the motor has finished its work for the day, but is still hot. This will serve to loosen what carbon may be collected, and it will be blown out with the exhaust when the motor is started the next morning. It is advisable to do this about once a week, although the use of the correct amount and proper quality of lubricating oil is an important consideration.

P. N. E. writes: "A few years ago several motor trucks of leading makes were designed with a differential lock. What was the purpose of this, and is it considered an advantage?"

A. The differential lock was designed to give the effect of a solid rear axle so that each wheel would revolve at the same speed, regardless of tractive conditions. It was designed especially for trucks that were to be used over country roads where there was a liability that one wheel would strike a soft and slippery place. In this case, the differential would transmit the motion intended for the one wheel to the other that was free to revolve, and this would spin at high speed without moving the truck. A means of locking the differential caused the power to be transmitted equally to each rear wheel, and therefore the one that rested on the good tractive surface would move the truck out of the mudhole. Of course the use of chains, ropes, or other similar devices would prevent this slipping and would serve the same purpose as locking the differential. It is claimed by some engineers that the differential on a motor car is a prolific source of skidding, but its use is necessary if it is desired to save tire wear.

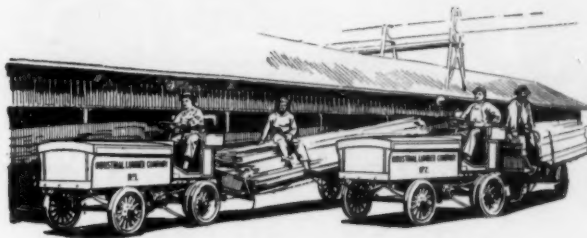
L. K. J. asks: "What is the attitude on the part of the leading truck manufacturers toward free service and maintenance guarantees?"

A. Many motor truck manufacturers are awakening to the injustice that is being done themselves, as well as the industry as a whole, through the abuse of service guarantees. The manufacturers cannot be expected to be held responsible for poor service obtained from a truck because of flagrant abuse on the part of the owner or driver. The most satisfactory system seems to be that in which the truck dealer undertakes to store and care for his client's car for a stipulated sum per month, and to guarantee service during certain hours of every working day of the year. For this guarantee, the dealer charges a sum sufficient to show a reasonable profit on the storage, gasoline, oil, and necessary overhauling, while repairs that are caused by defective parts are cared for by the factory guarantee. Such a service is maintained in many of the large cities where certain trucks are sold, and this system has proved advantageous to dealer as well as truck owner. If the service contract includes keeping the truck in repair, the dealer generally stipulates that he shall furnish the driver, and that the owner himself shall not be allowed to make any adjustments. Furthermore, the truck must be stored in the dealer's garage so that it will be constantly under his care and he may know that it is operated properly. Knowing the truck as he does, the dealer is then able to assume responsibility for its regular over-capacity whenever the first vehicle is out of commission. Such a system naturally saves bickering and hard feeling between truck manufacturer or agent and owner, and this is a healthy sign pointing toward the elimination of the much-abused free truck service.

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THE tractors shown have a 2-ton rating, a speed of 10 or more miles per hour, and a normal mileage of 35 per charge. We are building a 3½-ton tractor for the N. Y. Street Cleaning Department. (Repeat order.)

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Steinmetz Says:

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From an Approved Report of Some Contemporaneous Remarks by Prof. Charles P. Steinmetz at a Recent Meeting of Engineers.



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The Edison Nickel-Iron-Alkaline Storage Battery is the ONLY One. Contains no Lead nor Acid



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It has sixty horse-power, 144 inch wheel-base, 37-inch tires and a magnificent spring suspension, proving to you that nothing has been left undone to insure *easy riding and bodily comfort*.

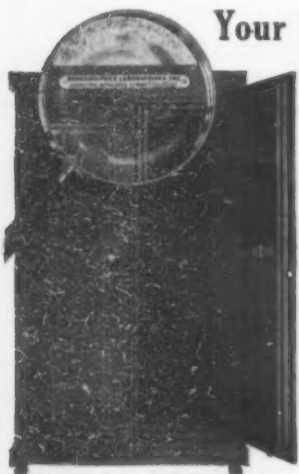
In addition to the above the car is upholstered with soft ten-inch cushions and is finished in a manner that will please you no matter how exacting your taste may be.

It offers more *car, more quality, more comfort, more power and longer life* than any car that is sold in America today at \$3,000. It is beyond question the *high-class, low-cost car* and you will experience a definite pride in its possession.

Equipment of the Big Six included in the list price—electric self-starter and generator—electric light plant—mohair top and dust cover—quick-action rain vision and wind shield—speedometer—extra removable rim—double extra tire carriers—license plate bracket—Bair bow holders—electric exploring lamp—electric horn—pump-jack and set of tools.

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A Triumphant Struggle With a Beetle

(Concluded from page 180.)

proportion of infections was very small. If 100 sound larvæ were imprisoned in a salmon case with say 20 infected ones and fed on rotting materials, no more than six or eight of the sound larvæ would, during these early days of experiment, be attacked by the fungus. From his own experiences with these beetles, and with this fungus, Dr. Doane did not see much relief in that direction, and so reported. However, Dr. Frederichs continued his patient labors and eventually he bred new habits into the fungus, created a new appetite for the living larvæ of the beetle, and at last produced such a virulent fungus, that when five or six infected beetles are confined with one hundred sound ones, 98 per cent or more will soon find themselves in trouble.

It has now become the custom in German Samoa to carry infected rubbish and beetle larvæ to the outdoor "Tumus," and deposit it in them, and as one of these is placed on every acre of coconut lands, and as the mother beetles are very fond of these artificial nests, nearly all of the eggs deposited come to nothing at all.

The strength and efficiency of this fungus has now so greatly increased that many of the mother beetles coming to oviposit are themselves attacked and they fly away with enough of the infection to poison the galleries in the coconut trees and spread the contagion among their neighbors.

The Samoans who under the law gather beetles and larvæ every Monday morning are now bringing in quantities of fungus-fed beetles, and the plague is very much abating.

Here in the islands we regard this achievement as a remarkable one; and as this means of combating the greatest enemy the coconut tree has, ought to be known in all tropical countries, we send it to the SCIENTIFIC AMERICAN, which circulates everywhere, and whose word is taken as emphatic and dependable.

Prolonging the Naval Stores Industry

(Concluded from page 173.)

trees or in cutting the boxes preparatory for the next season's flow. As a result of this work a certain amount of crude turpentine is collected during the winter, but it is almost entirely from ducts already in the wood and not from secondary ones. The flow of this resin does not continue very long, for the wound becomes clogged, presumably from oxidation and crystallization of the resin, and the flow ceases.

The secondary resin ducts formed above the wound are filled with resin which has no opportunity to escape until a thin chip is cut off. When this is done the flow is much more vigorous than from the original wound. In about a week, however, clogging up occurs again and another chip must be removed. As this wound extends slowly up the tree new or secondary ducts keep pace with it. If too large a chip is cut the productive secondary ducts are cut off and the run materially lessened.

Failure to understand the physiology of resin formation and to adjust the methods of turpentine orcharding to it has resulted in untold losses and a very serious depletion of a valuable resource. It is also responsible for one of the chief criticisms against the cup and gutter system. It is a common experience that, although the total yield from the first year of the operation is greater than under the box system, nevertheless an unusually large number of weekly chippings has been found necessary to secure the first dipping from cups—six to seven chippings as compared to four under the box system.

In the light of the above explanation of the formation of secondary resin ducts this shortcoming is readily explained and avoided. Under the box system the boxes are cut during the winter and the trees are "cornered," that is with the upper edge of the face ready for chipping. The new ducts form, the first chip opens them up the full length of the cut and a good run is at once secured. In placing cups, however, the common practice has been

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Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

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Inquiry No. 9352. Wanted the name and address of a person who is in a position to get the state or county agency for articles of merit that can be sold to business houses or others at \$3.00 or over. No kitchen utensils desired.

Inquiry No. 9353. Wanted the name and address of a manufacturer who can make flexible oil cans.

Inquiry No. 9354. Wanted the name and address of a manufacturer of a machine which will stitch silk around small metal rings.

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Inquiry No. 9356. Wanted the name and address of a manufacturer who can build an automobile wheel, also a cigar vending machine. Concerns in the middle West preferred.

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Inquiry No. 9359. Wanted the name and address of a firm that makes razor blades for all makes of safety razors.

Inquiry No. 9360. Wanted the name and address of parties making pipe fittings such as ferrules, stems and bowls such as could be used in the making up of calabash pipes for smoking.

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to make with the broad ax two flat faces, meeting at the center, on which the cuts for insertion of the gutters are made. The upper portions of these faces have oval outlines instead of straight as in the preceding case. The resin ducts formed follow the curved upper edges of the faces. The first chipping is made from each side to the center, and the result is that instead of the new ducts being opened up along the entire cut, only those near the middle of the face are cut. Naturally the flow at first is considerably less than where the trees are "cornered."

The solution of the difficulty presents itself immediately the cause is understood. During the winter months, when the gutters are placed upon the trees, the chipper should make a regular chipping the full width of the face. Secondary resin ducts will form along the entire length of this cut and the first application of the hack in the spring will start them all to flowing at once. Actual tests have demonstrated the correctness of the theory and resulted in a gain of one extra dipping or about thirty barrels of crude turpentine per crop of 10,000 cups. The saving to the entire industry is enormous.

French turpentine is considered superior to American. It is obtained from maritime pine (*Pinus maritima*), which produces a resin yielding 25 per cent turpentine as compared to 17 per cent for long leaf pine. The tree has the ability to grow rapidly on poor sandy soils. The United States Forest Service is now experimenting with it in Florida, and the prospects are so far very promising. Maritime pine grows more rapidly than loblolly and produces more resin than long leaf. It attains size large enough to cup in thirty years as compared to one hundred years for long leaf. There are large areas of cheap land in the South which are well adapted to its growth in case the experimental plantations fulfill their present promise of success.

The Heavens in March

(Concluded from page 182.)

The Planets.

Mercury is evening star until the 10th, when he passes through inferior conjunction and becomes a morning star; but he can only be well seen at the very end of the month, when he rises an hour before the Sun.

Venus is evening star, and is coming into sight again, so that by the end of March she sets an hour later than the Sun, and is easily seen.

Mars is in Gemini, long past opposition, but still about as bright as Procyon. During the month he moves eastward about 10 degrees, and his motion can easily be followed with the naked eye, even from night to night, especially on about the 8th, when he passes about 1 degree north of the third magnitude star ϵ Geminorum.

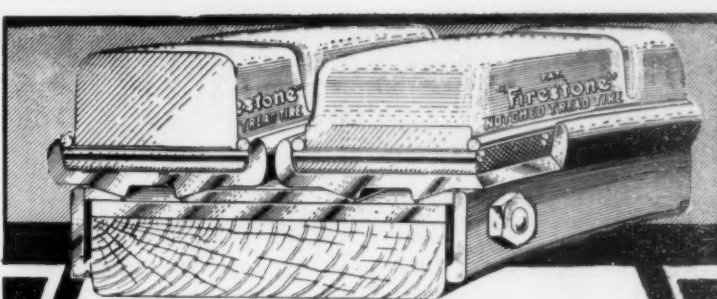
Jupiter is a morning star in Capricornus, rising about 4:30 A. M. in the middle of the month. Saturn is in quadrature with the Sun on the 2nd, and after this counts as an evening star, though he remains visible till about 1:20 A. M. at the beginning of the month, and 11:30 P. M. at its close.

Uranus is a morning star in Capricornus. At 4 A. M. on the morning of the 4th he is in conjunction with Jupiter, being south of the brighter planet, at a distance of only nine minutes of arc. The two planets will be separable only with the aid of a field-glass, and Uranus will appear about as near Jupiter as his own satellites, but in quite a different direction. Unfortunately, this interesting conjunction can only be observed under rather unfavorable conditions, at about 5 A. M.

Neptune is in Gemini, and crosses the meridian a little after 8 P. M. in the middle of the month.

The Moon.

First quarter occurs at midnight on the 4th, full Moon at 11 P. M. on the 11th, last quarter at 3 P. M. on the 18th, and new Moon at 1 P. M. on the 26th. The Moon is nearest us on the 12th, and remotest on the 27th. She is in conjunction with Saturn on the 4th, Mars on the 6th (pretty closely), Neptune on the 8th, Uranus on



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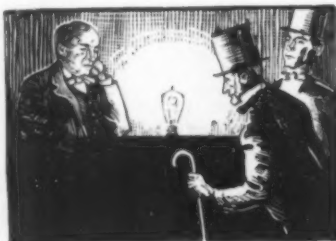
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the 21st, Jupiter on the 22nd, Mercury on the 24th, and Venus on the 27th.

At 6:03 A. M. on the 21st, the Sun crosses the celestial equator and "Spring begins," technically speaking; and on the night of the 11th there is a large partial eclipse of the Moon, which is well observable throughout the United States.

The Moon first reaches the penumbra of the Earth's shadow at 8:41 P. M. by Eastern standard time. The umbra, or dark shadow, is not reached till 9:42. From this time on the eclipsed area increases until, at 11:13 P. M., eleven twelfths of the Moon's diameter is immersed in the shadow. Then the eclipse diminishes, and the last contact with the shadow occurs at 12:44 A. M., though the Moon does not clear the penumbra till 1:45.

This eclipse is so nearly total, and occurs at such a convenient hour of the evening, that it should be watched by great numbers of amateur observers.

Further observations of Delavan's comet, of which we spoke last month, and the orbit calculated from them by Van Biesbroeck, show that its perihelion distance is actually about ten per cent greater than that of the Earth, the inclination of the orbit about 68 degrees, the motion direct, and the perihelion passage not until October 26th, 1914. The comet is still very unusually remote from both Earth and Sun, its distance from the latter being more than four astronomical units at the time of discovery. It must be a very big comet to be visible at all at this great distance. When near perihelion next October it will be high in the northern sky, probably visible to the naked eye, and perhaps fairly conspicuous, though its perihelion distance is rather large for the formation of an extensive tail. At present it is of the magnitude 10.8, and its position is as follows:

	R. A.	Declination.
March 1	2h. 42m. 22s.	3° 40' N.
March 13	2h. 47m. 21s.	5° 54' N.
March 25	2h. 54m. 12s.	8° 9' N.

It is getting rather near the Sun, and is observable only in the early evening. Princeton University Observatory.

The New Wright Aeroplane Control
A NEW form of aeroplane control has been devised by Orville Wright, and is thus described by him:

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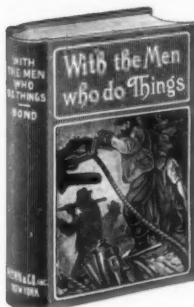
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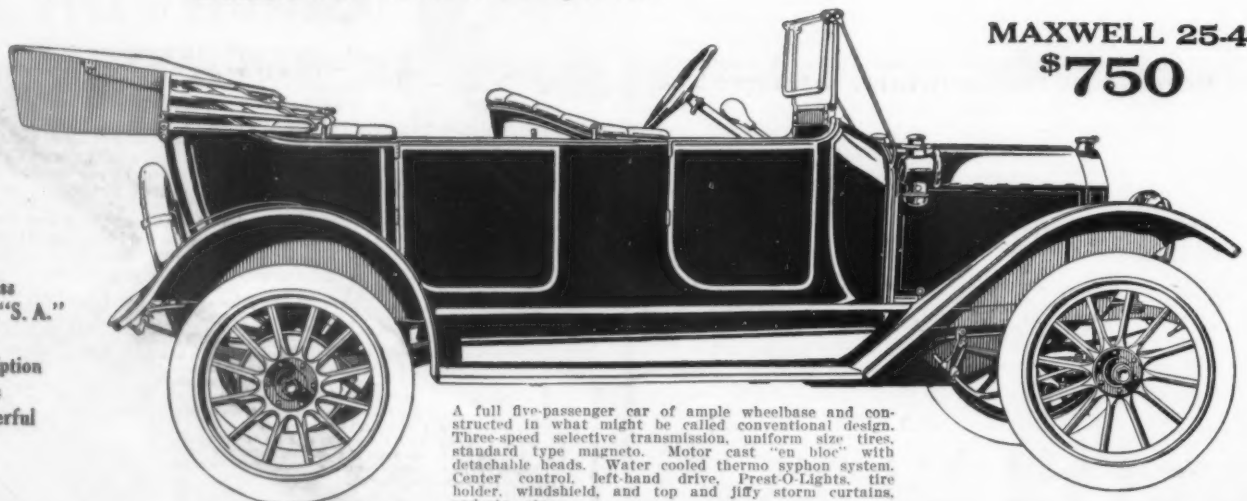
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